Small Woodworking Planes

THE MODEL ENGINEER

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Mr. Winston Churchill broadcast that over a million women are required in the armaments industry. Our photograph shows one of these workers operating a sensitive drill at a factory "Somewhere in England."

THE MODEL ENGINEER

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Smoke Rings

The Utility Value of Model Making

I GIVE below an extract from a letter written by Mr. T. M. McLaughlin, of Auckland, N.Z., to our contributor Mr. W. L. Randell, as the result of the article by the latter in our 2,000th number. In his letter Mr. McLaughlin says that he has often felt inclined to write to the Editor of THE MODEL ENGINEER, but "as my views and his writings were so different, I thought it would be useless." I do not mind anyone disagreeing with me, and as Mr. McLaughlin is obviously very honest in the views he expresses, I reproduce them herewith. He writes :—"For some years I often thought of writing to the Editor, but as my views and his writings were so different I thought it useless. One day, however, I noted the Editor's obituary notice of George Adams (with whom I had had business and who was a very likeable man), and this decided me. The Editor set down the fact that Mr. Adams was a very able engineer, a good friend to all men and boys who enjoyed working with tools, and spent much time in his own private workshop. Many attempts had been made to get Mr. Adams interested in model making and exhibiting, but 'he could see nothing in it and believed that the purpose of a workshop was to produce something *useful*.' I am positive Mr. Adams was right. Ever since I was seven years old (and that is a long time ago), I have had a workshop, and cannot understand how so many men get along without one, but I am glad that the thousands of hours spent with forge and anvil, lathe and drilling machine, and also in the using of many other tools for wood as well as metal were not employed in model-making. A boy or man can get experience and pleasure in the use of tools while making useful things ; and it is a pleasure for me to know that many things I have made, and are in use every day, will be doing useful work long after I have passed on. A week never passes without my doing some job for a friend or neighbour, or perhaps a child, for which I get nothing, but it brings joy to others, and that is enough for me. I take no credit for doing such work. I was brought up that way, and my father had done ten times more for others than I have, but if I had been allowed to shut myself up in a little workshop making little locomotives I would probably be a 'little' man today. Unfortunately there are tens of thousands of little men in England. I know this, because although born in New Zealand, I have spent some time in dear old England twice. William Morris (whom you mention) was not a little man, and you could not picture him working just for his own pleasure. In THE MODEL ENGINEER we often see a picture of a man, perhaps 40 or more, sitting on a little engine and playing at being the driver of a Great Western express. It is pathetic, and behind it must be years of spare time which could have been usefully employed, and given joy to others who were not so fortunately situated as himself." I am glad to know that Mr. McLaughlin gets so much pleasure from his workshop, and has used his skill for giving pleasure to others. He is perfectly right to use his equipment for the ends he thinks best ; his workshop and his hobby thereby admirably fulfil their purpose. His work has been a pleasure and not a task. That is true recreation. But that is not to say that other people who use their workshops to build model locomotives, or other kinds of models, are wrong. Model engineers follow their hobby for many different reasons, the principal one being to obtain healthful and pleasurable recreation, and if this is the object, it does not matter very much whether the outcome is a model locomotive, or the repairing of a sewing machine for a friendly neighbour. It must not be forgotten that model locomotives give pleasure to many other people besides the builder, and in some cases have been the means of raising considerable sums for benevolent objects. Moreover, models have been of immense value in the development of inventions, and in technical research. I have many readers who hold much the same views as Mr. McLaughlin, and I respect them for it. Indeed, if they were compelled to build models, their interest in their hobby would quickly disappear. But their workshop gives them the recreation and the change of thought and occupation, which makes for a sound mind in a healthy body. When people ask me, as they sometimes do, what is the good of model making, I often quote a remark made by Dr. J. Bradbury Winter, famous as the

builder of that most perfect scale model locomotive the "Como," now in the Brighton Museum. Dr. Winter built this model in his spare time, when practising his profession. He spent 13 years in building the locomotive, apart from the tender, and someone said to him: "Don't you think, Doctor, you could have spent all that time to better advantage?" He replied, "Certainly not, I have had 13 years of enjoyable recreation in building that model, and the rest and relief from my daily work, has enabled me to give better service to my patients." An excellent answer, surely, and one which applies to so many busy men, who, by the way, are not always "little" men, as Mr. McLaughlin puts it. Some of our greatest engineers and men of affairs have found in the model locomotive the secret of successful recreation. We all have our own solution to the problem of using our spare hours wisely and well, and because our own desires dictate one kind of occupation, we should not lightly regard the activities of others who may think differently.

* * *

News from Dublin

I AM pleased to hear from the Hon. Secretary, Mr. J. A. Minnis, that the Dublin Society is in an active and even flourishing condition. The membership is close on the 50 mark, and, though it has not increased in numbers, Mr. Minnis tells me that it now includes more working members than he can remember for a long time. He adds that this is "highly gratifying to the Secretary's soul, if such a person has a soul." The track for the loco. members has been completed, and Mr. Minnis promises to send us a description. This section of the club is very active, and a number of "live steam" models are in operation. One of the best of the locos. is an "0" gauge tank loco. of the Great Southern 0-6-2 type, built by a member with a home-made lathe, and in the face of serious physical disability as the result of a motor crash. Mr. Minnis says it is a perfect marvel of craftsmanship. A recent recruit to the membership is a lady who, I am told, "knows as much as the best of us, and can use a lathe without any bother at all." The Nautical Secretary of the Society recently gave a very inspiring broadcast on hobbies from the Dublin station, and presented the virtues of model engineering in an appropriately attractive fashion. Thanks to the sympathetic co-operation of the Dublin Corporation, the Society now has a nice boat house near their sailing water, and has obtained consent for the exclusive use of the pond for their sailing and power boat members. Except for rising prices, Mr. Minnis says that the war so far has not affected the activities of the Society. All this is good news, and I would wish the Dublin members long continued enjoyment of their hobby in its various forms.

To Inventors

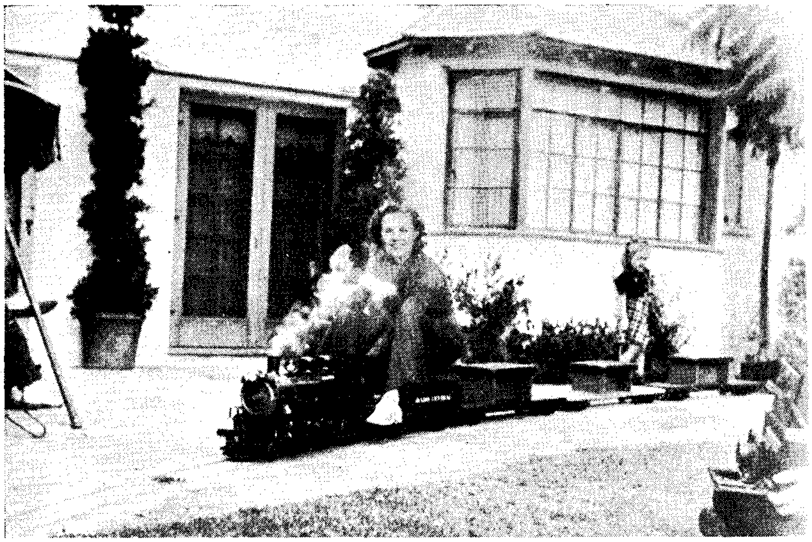
IN a letter recently to hand, Sir Arrol Moir, Bt., B.A., A.M.I.C.E., Vice-President of the Institute of Patentees writes:—"During the last war, invention was one of the key industries of the country and is still more so to-day, both for the promotion of victory and for the speedy revival of trade afterwards. I am anxious to make it known, therefore, that inventors with ideas of any kind, either for the fighting services or for peace-time trade, will be given full support by the Institute of Patentees if they will apply by letter and state the nature of their work. Our object is to collect war and other inventions which may be of use to the country and launch them by submission to the proper authorities and firms, as this organisation has for its primary purpose the protection of inventions, and we are ready to give them every assistance in carrying out their aims of national importance. Inventions of any kind, however simple, are welcome and they will receive the earnest attention of a competent Technical Committee. Use us, therefore, for the preparation and introduction of your brain-power alone for enlistment to the full and lasting advantage of your country." Any reader who may have invented some contrivance that may be applied to some useful national purpose should write to The Secretary, Institute of Patentees, 10, Victoria Street, London, S.W.1, sending full particulars of the invention.

* * *

Model Marine Engines

IN a letter recently received, a reader made a very strong plea for a revival of interest in models of triple, or quadruple, marine engines, and suggested that the "M.E." could help by publishing an appropriate design. While there is a great deal that could be said for this idea, it is by no means so certain that the demand is sufficient to justify the expense involved in preparing the necessary drawings. The multi-expansion marine engine is a highly elaborate piece of machinery; and, unless a model looks right, and *is* right, it is scarcely worth the time and trouble involved in its making. There are several reasons to account for the decline in popularity of the model marine engine, not the least of which is that the prototypes are now regarded, by the rising generation of the technically-minded, as being obsolete and old-fashioned. This is a pity, from many points of view; but the fact remains that the construction of such models appeals, now, only to a small minority possessed of an abundance of time, patience and skill.

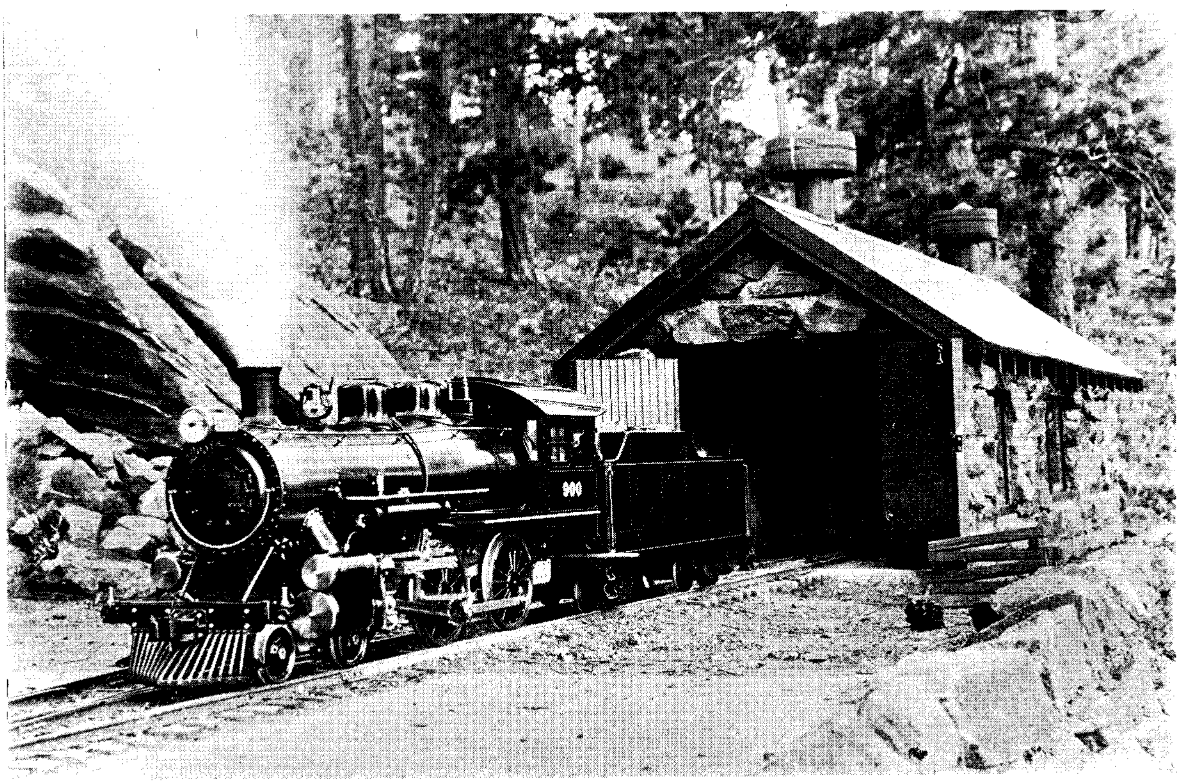
Percival Marshall



Mrs. Arthur D. Stump on the footplate.

An American 4-4-0

SOME recent notes by "L.B.S.C.," referring to the miniature locomotive activities of Mr. A. W. Leggett, of Montreal, Canada, reminded us of some photographs that were left here by Mr. Arthur D. Stump, of Los Angeles, California, when he visited us some while ago. We reproduce some of these pictures herewith, and we are sure that the locomotive depicted in them will be as much of a surprise to many of our readers as it was to us. Instead of being another example of the "Pacific," "Baltic," "Mountain," "Mikado," or some such hefty modern type, she is just a humble 4-4-0, of neat free-lance design; that is to say she is not an exact copy of any particular prototype, but she is typical of the past practice of her country of origin. She takes our fancy very much, not

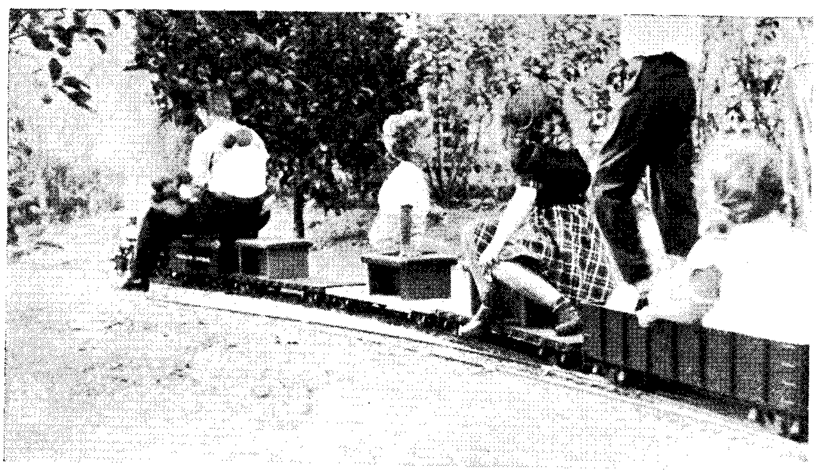


Mr. R. B. Jackson's "free-lance" 4-4-0 soon after completion of construction.

A fairly good load for 5-inch gauge.

only because of the excellent workmanship that has so obviously been put into her construction, but because of the extraordinary care and faithfulness which have been just as obviously applied to her lines and proportions, all combining to produce a most pleasing effect. The picture in which the engine is seen standing outside her shed, is deceptive to a degree; we think that few MODEL ENGINEER readers could say, straight away, what size the engine is, and we do not mind admitting that our own first guess was a long way out!

Actually, this engine is for 5-inch gauge; and some idea of her powers can be assessed from the other photographs reproduced, which show her at work. She was designed and built throughout by her owner, Mr. R. B. Jackson, of Beverley Hills, California; her cylinders are $1\frac{1}{8}''$ diameter, and have a stroke of $2\frac{1}{4}''$, driving wheels having a diameter of about 6″. At the moment of writing, we have no further particulars of the dimensions or equipment of this engine; there are, however, one or two features that can be discerned from the photographs.



Passengers entraining for a trip.

The valves are obviously of piston type, and are operated by orthodox Walschaerts valve-gear which appears to have been very carefully designed, to say nothing of the fine workmanship that is so clearly apparent. But a very significant point is revealed, indirectly, by a study of the illustrations. In one picture, a respectable load of seven persons is seen, including the driver; this is by no means unusual or severe for a 5-inch gauge engine, but, if we have given the cylinder sizes correctly, it shows that "under-scale" cylinders are not necessarily "under-size"! If a good boiler is provided, under-scale cylinders usually give surprisingly good results, especially if they are supplied with ample ports and steam passages. That this particular locomotive gives no trouble is evident from the joyful expression of its fair driver, Mrs. A. D. Stump!

We hope to be able to publish further particulars of this engine, and some description of the railway which, when the photographs were taken, was not completed; as a matter of fact, it is in process of being re-laid on a new site.

We are interested to note that the track is laid on the ground, and is not elevated at all, except on embankments or over bridges.

Good Work at Leeds

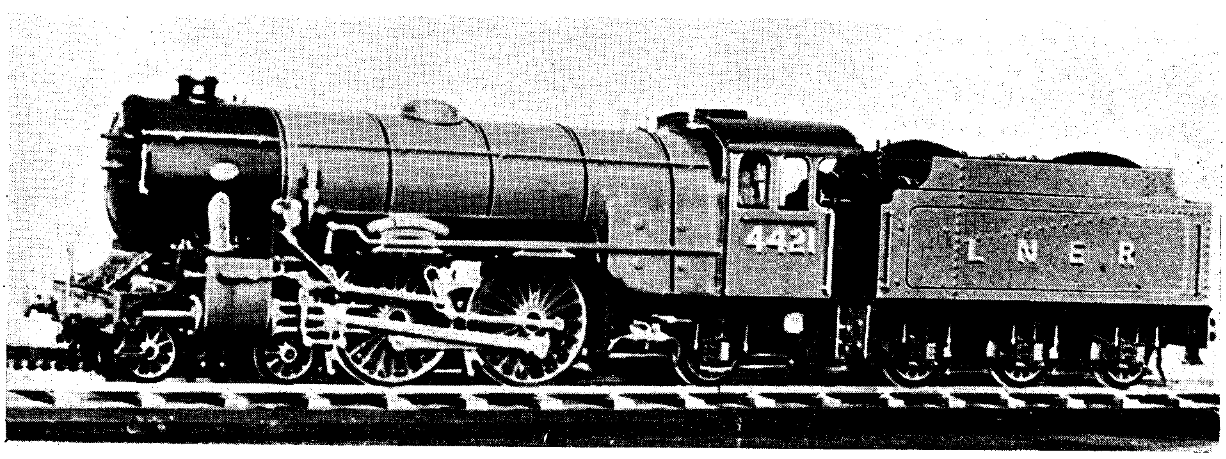
By "L.B.S.C."

MOST folk like to know something about what "the other fellow" is doing—the lads of the R.A.F. who run half-day trips over the land of the swastika, for instance ("for further particulars see small bills"?) so here are some items of news from Mr. W. Lynch, of Armley, taken from a long and interesting letter recently received. Incidentally, Mr. Lynch and Mr. Haswell, who holds the record of being the first to complete a $2\frac{1}{2}''$ gauge G.W.R. "Grange" from the instructions I gave some time ago, are fellow-workers in the same engineering firm, so no wonder your humble servant's ears burn sometimes during working hours!

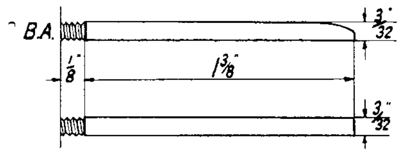
Both Messrs. Lynch and Haswell are changing over to $3\frac{1}{2}''$ gauge, on account of a $3\frac{1}{2}''$ gauge "Maisie" built by another Leeds enthusiast, Mr. Taylor. This engine has done some wonderful work; for example, it has run for six hours at a stretch, at a carnival, and will pull enormous loads, just like the full-size article on the L.N.E.R. In fact, Mr. Taylor has just completed a three-cylinder L.N.E.R. Pacific, but so far it has not done anything which "Maisie the Umptieth" could not tackle. The four-coupled engine is a little slower starting the big load, but she *does* start it, and gets away with a crack enough to blow the chimney off. Anyway, Mr. Lynch decided to go in for a $3\frac{1}{2}''$ gauge Atlantic, of larger dimensions than "Maisie," and designed one that is only $1\frac{1}{2}''$ shorter than a Pacific. The cylinders are $1\frac{3}{8}''$ by $1\frac{5}{8}''$, driving wheels $5\frac{1}{4}''$ diameter, boiler barrel $5''$ diameter, with twenty-five $7/16''$ tubes and two $1\frac{1}{8}''$ superheater flues, and a firebox $5\frac{1}{2}''$ by $5\frac{3}{4}''$. Some engine! The valve gear is Walschaerts, and the engine will start a load of eight passengers with the lever one notch off middle.

Last autumn, at a carnival just outside Leeds, this engine was hard at work on passenger hauling for about five hours; and after the crowds had dispersed, her owner and some other members of the Leeds club thought they would have a bit of fun with her, and see what she really could shift. All the cars were coupled on, and a dozen passengers squeezed on to them. After slipping a couple of turns, away went the engine with the lot; not so bad after five hours' hard steaming. Mr. H. P. Jackson, of York, was also present with a $3\frac{1}{2}''$ gauge L.M.S. Pacific, which put up a fine show.

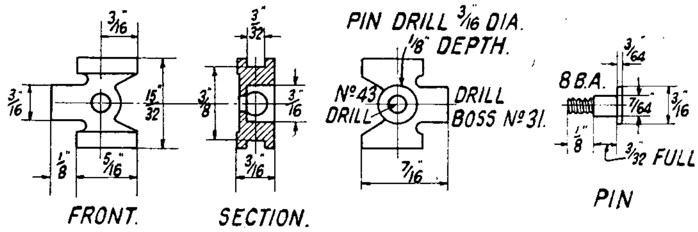
However, the Atlantics will have to take a back seat when Mr. Haswell's new baby learns to walk. This one is a $3\frac{1}{2}''$ gauge 2-8-2; I have no particulars of her at present, but hope to show a picture of it, also the one mentioned above, at some future date. Judging by the performances of "Newsam Grange," it should be a winner. By the way, the engine just mentioned had a lovely spill one night at a track meeting of the Club. She was just getting away nicely with a big load, when the coupling on the car gave out, and the locomotive "slipped coaches" with the regulator wide open. Mr. Lynch says he never saw a little engine travel so fast in all his life! Mr. Taylor was sitting on a car at the other end of the line, and the little "Grange," which somehow managed to keep the rails, crashed into it with such a smack that it was knocked back a yard, passenger and all, whilst the locomotive jumped into the air, and came to earth six feet away from the "point of contact." Our worthy friend says that the owner's face was a picture, and I well believe it! Anyway, he had the profound sympathy of every locomotive builder present, but many hours of hard work



A $2\frac{1}{2}$ in. gauge "Atlantic" designed and built by Mr. W. Lynch.



Guide bar.



Crosshead.

were needed before "Newsam Grange" could take the road again.

The swastika casts no shadow over the lads of the Leeds Club; locomotive work is proceeding apace (among those being built is a 5″ gauger), and they hope to hold their annual exhibition as usual, in the early spring, and put up some good performances. Here's wishing them all the best! The engine shown in the picture is the second of Mr. Lynch's 2½″ gauge engines—the first was a "Mary Ann"—and is really a smaller edition of the 3½″ gauge Atlantic mentioned above.

THE "BAT"

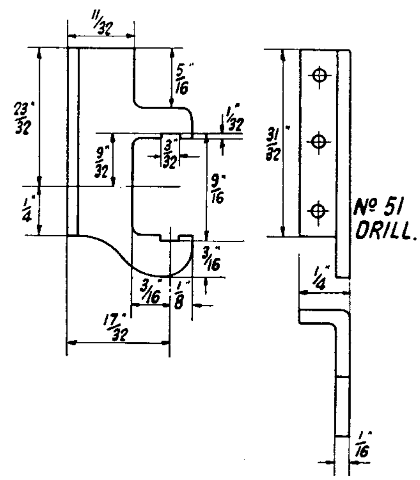
Guide Bars and Crossheads

Before I forget it, here is a small item of information. Some of our readers are impatient to see the outline and first details of the second "blackout bird," the "Owl"; so, circumstances and our good friend the Knight of the Blue Pencil permitting ("For he's a blue-pencil good fellow, and so say all of us!") I hope to include them in the next couple of weeks or so. This nocturnal ornithological "Live Steamer" is an 0-6-0 based on the L.M.S. "4F" class, and has two inside cylinders; a nice job of work for the ham-fisted fraternity, but worth it when done. As the tender will be the same as that of the "Bat," and the boiler and top works do not vary a great deal, we can kill two birds with one shot, which wants a bit of doing in the blackout! Now for some more "Bat" details.

For the guide bars, you will need four 1½″ lengths of 3/32″ square silver steel. Chuck each in the four jaw, and turn down ⅛″ of the end to a shade under 3/32″ diameter; screw 8 BA with a die in the tailstock holder, Tip: many readers who have no four-jaw chuck, want to know if they can use the three-jaw for chucking square stuff. Certainly; or any other section, if it comes to that. All you have to do is to measure over the corners of the rod it is desired to hold. Chuck a piece of metal a little larger in diameter than this measurement, and about four times as long. Centre and drill it to the diameter over the corners of the rod, so that the rod will slide in easily. Put a dot on the bush opposite No. 1 jaw, remove bush, and split it down one side with a hacksaw. Replace in same position, insert rod, and tighten chuck; the rod, held by the corners, will run truly. Another tip: inexpensive Continental chucks, e.g., the "Crown" brand, have an arrow stamped on the chuck body, pointing to one of the key holes. If the key is used in that particular hole when tightening up the jaws on something that needs to run truly, it will do so.

Yet another tip (three tips running, would be the waiter's dream of Paradise), screw the guide bars home in the covers, and *then* file the bevels; otherwise, by a well-known law of Nature, they are bound to come upside down when right home, and by another ditto, are equally certain to break off short in the hole, whilst you are trying to coax the other half turn in order to bring them right.

Although steel crossheads look pretty, in this small size they will work sweeter if made from bronze or hard brass. They can be tinned over to look like steel, if you care to take the trouble. A piece of bar of 3/16″ by ½″ section, and just over an inch long, will make the pair of them. First mill the grooves by any of the methods described

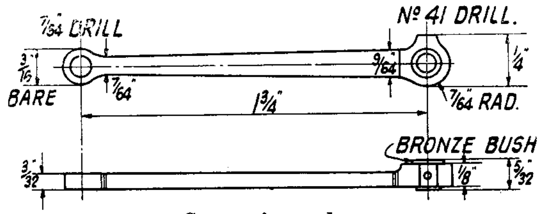


Guide yoke or motion bracket.

for axleboxes some weeks ago; then chuck the piece truly in the four-jaw, and turn down ⅛″ of the end to 3/16″ diameter. Reverse and repeat operation. If no four-jaw is available, mount between centres; only be careful that your centre holes *are* in the centre, or there will be some more railroad Esperanto flying around when trying to fit them to the guide bars! Part or saw the pieces in half; mark out and drill the No. 43 holes for the crosshead pins, then pindrill same 3/16″ diameter and a full ⅛″ depth, to accommodate the

little ends of the connecting rods. Judicious application of a small file, will now bring the crossheads to the shape shown in the sketches. I have shown the outside face slightly relieved in the middle, for appearance sake, but this is not essential; leave them flat if you so desire, or else make two very shallow grooves with a rat-tail file, between the shoes and the pinholes, which makes them look like the full-size built-up article.

The crosshead pins are turned up from 3/16″ round steel, a simple job needing no detailing out. Have the bearing part as smooth as possible. Ordinary commercial nuts are used for securing the pins.



Connecting-rod.

Freedom of working being essential to "pocket size" locomotives, fit the crossheads to the piston rods by the old well-tried wheeze, which, in case tyros do not know of it, is as follows. Take off back cover with guide bars attached; put crosshead between bars, and run it up to the gland. Put a $\frac{1}{8}$″ drill through the piston rod hole in the cover, and holding the crosshead boss tight against the gland, make a countersink on it with the drill. Remove, and drill boss at the indicated spot, with No. 31 drill, which should leave a hole a tight fit for the piston rod. Drilling should be done with the crosshead chucked in the four-jaw, set so that the countersink runs truly; use the tailstock chuck for feeding up the drill. Reassemble, but do not pin the crossheads to the piston rods until the connecting rods are made and fitted.

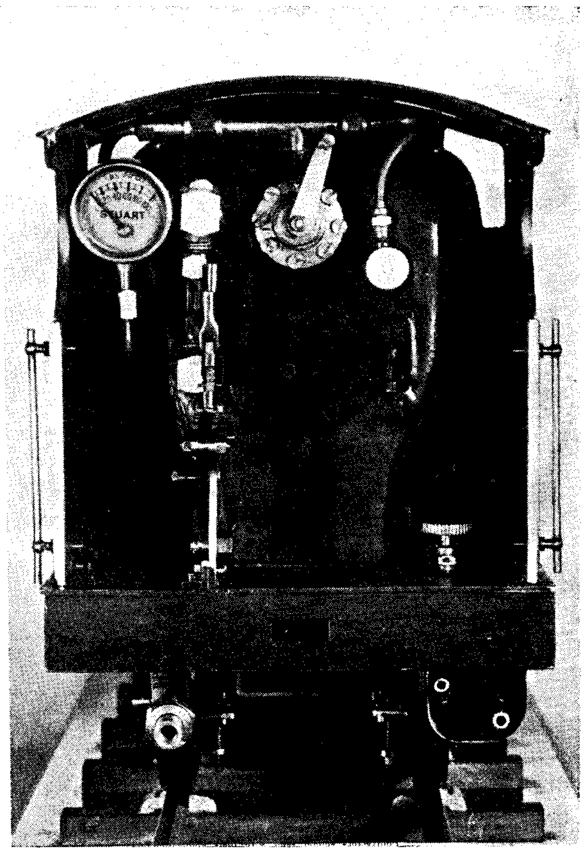
Guide Yokes or Motion Brackets

In this small size, the easiest and quickest way to make guide yokes, is to bend them up from a bit of soft steel sheet, 16 gauge. Mark out, and saw and file to outline, the two pieces being clamped or soldered together, but do not file the nicks for the guide bars. Bend over the edges as shown, one right-hand and one left, for forming the attachment to frames, and drill the three screw holes, the exact position of which does not matter. Then stand each yoke on your lathe bed (or something equally flat) on its angle; and with the needle of the scribing block set 17/32″ "above zero," scribe a line right across both jaws. Set out the guide bar nicks on this line, and file them separately. This will ensure that the guide bars are held truly in line with the piston rods, and at correct distance from frames.

Connecting-rods

These can be milled or filed up from $\frac{1}{8}$″ by $\frac{1}{4}$″ flat steel rod, same way as for coupling rods. Note that the big end only, is left the full $\frac{1}{8}$″ thickness the little end being the same thickness as the rest of the rod, in order to fit in the crosshead recess. As the little end eye takes all the driving strain, it can with advantage be hardened, by heating to red, dipping in "Kasenit" or similar hardening powder, reheating until the yellow flame dies away, and quenching out in clean cold water. It should fit on the crosshead pin easily, but without shake.

Drill the big end 5/32″, and fit a little bronze bush, which should be a tight squeeze fit, and stick out 1/64″ each side, giving a bearing surface



Footplate of the L.M.S. "4F"—A north-countryman's first attempt. (*See also page* 119, "*M.E.*," *February* 1, 1940.)

of 5/32″ on the crankpin. If the bush is drilled No. 41, it should just be a nice fit on the pin.

How to Erect Cylinders

First assemble up the cylinder with crosshead and connecting -rod all complete, and slip the guide yoke over the bars. Then place the cylinder in approximate position, with the guide yoke flange against the frame, and the big end on the crankpin. Hold temporarily by a big clamp right over the outside of cylinder, and the opposite frame; but keep the clamp clear of the screw

(*Continued on page* 166)

*Model Aeronautics

In this instalment the author gives guidance in woodworking for the benefit of those who suffer from the "Mr. Can't" complex

By Lawrence H. Sparey

HOW often has one heard the remark, made by model engineers: "O! I'll tackle anything in metal, but I'm no good at woodwork!"?

Now, there is no particular virtue in being unable to work *any* substance, and it would seem that, in this instance, the old saying, "He can who thinks he can," has been altered to "He can't who thinks he can't." A glance at the exhibits at past MODEL ENGINEER Exhibitions seems to bear out the fact that many skilled fingers become thumbs under the paralyzing influence of this complex. One notes the badly fitting joints, the rough end grains, the clumsy mouldings, revealed rather than concealed by the sticky coating of varnish. Can it be, as one very skilled model maker, well known to readers of this journal, said to me recently, that good woodwork is too *difficult*?

Be that as it may, those who decide to make the small planes which form the subject of this article, will find them a nice exercise in this somewhat neglect branch of their craft. They were made, primarily, for use in carving model aircraft propellers; but they may be of undoubted value to builders of boats, pattern makers and others.

The smallest is $1\frac{5}{8}''$ long, while the largest is $4''$. Fig. 119 shows a close-up view of these two tools—with a penny to convey the actual proportions. The shape of the under-surfaces and cutting irons of these six planes differs in each case. Some have flat under-surfaces; others are semi-circular; while others have a flat, radiused working-face.

Good, well-seasoned beech wood was chosen for the three larger sizes; the smaller ones are of box-wood. Probably box is the better material, but it is difficult (and expensive) to obtain box-wood in large sizes, because, I understand, the box-tree is so slow in growth. An excellent alternative to either of the above woods is provided by teak. This is close-grained, tough and heavy, and is, strangely enough, comparatively cheap and plentiful at the moment. Inspection of the photographs in Figs. 120 and 121 will show that the planes are of two types. There is little to choose between them for efficiency, although the type illustrated in Fig. 120 looks the prettier little job when completed. As will be evident from the picture, this plane has had considerable use, and bears the scars of some years of workshop treatment. This proves that these tools are by no means little toys, but are real, useful implements. Of the two sorts, that in Fig. 121 is the easier

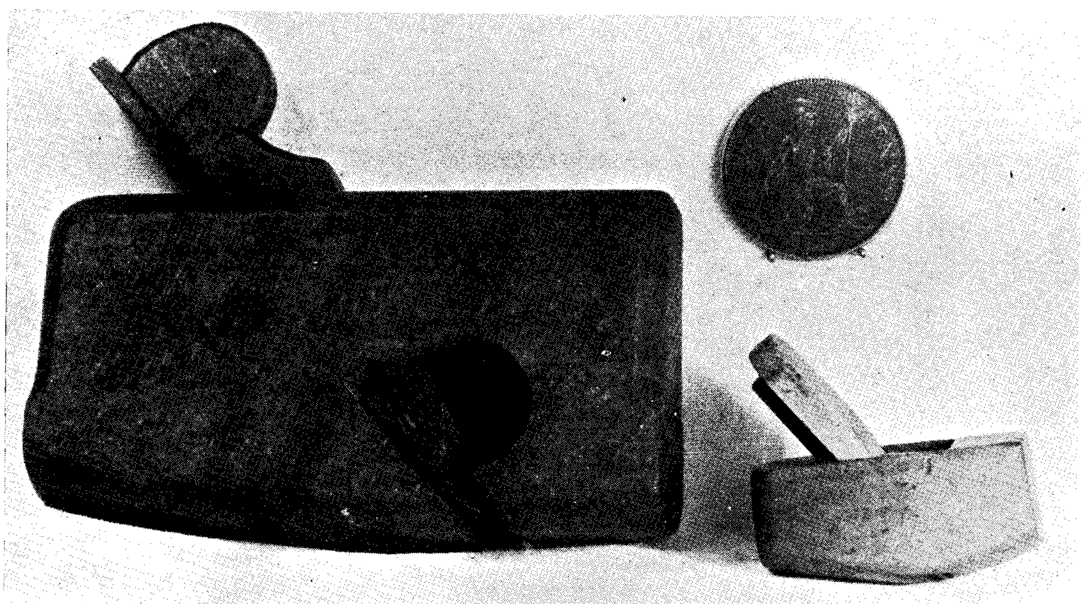


Fig. 119. Two model-making planes.

* *Continued from page* 82, "*M.E.*," *January* 25, 1940.

to make, and the drawing in Fig. 122 will convey principles. The sizes given are of an actual plane, but they may be scaled up or down with equally good effect. The plane selected is roughly boat-shaped in plan, and is useful for planing against a concave radius—such as might be presented by the inner wall of a circular box. On the other hand, Fig. 121 shows a plane with a rectangular plan form.

Having selected the piece of teak, which should be free from knot-whirls and twisted grain, it should first be planed up into a rectangular block of slightly larger dimensions than those of the finished tool. It will be found easier to plane to an even thickness if the slip of wood is considerably longer than the actual piece required. When the thickness has been attained, the wood may be cut to length. The next step is to determine the position of the $\frac{5}{8}''$ hole—which provides clearance for the shavings—and to bore this right through. It will be easier to get the hole square with the sides if it is bored at this

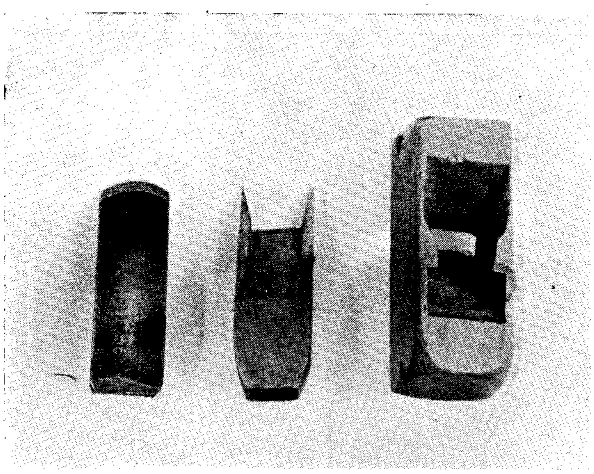


Fig. 120. Small plane of box-wood.

stage, rather than to leave it until the sides have been curved. This curving is the next process; the plan form will be duly marked out on both the top and bottom of the block, and the wood cut carefully away (with our old friend, the spokeshave) and sanded to smoothness. During this process, frequently check the sides for squareness to the edge. I would counsel you, if you are not used to woodwork, to proceed as slowly and with as much care as you would exercise if working upon a metal object.

Having thus shaped and prepared the block, it should be marked out as shown in Fig. 123. In this manner, the rectangular opening in the top of the plane (for the reception of the peg, and the shaft of the iron) is drawn on the top surface, and the angle and taper of the slot is marked on both sides of the block. Now, with a fretsaw, cut out the wedge-shaped piece of wood from the bottom of the plane to the $\frac{5}{8}''$ hole, and cut out the side

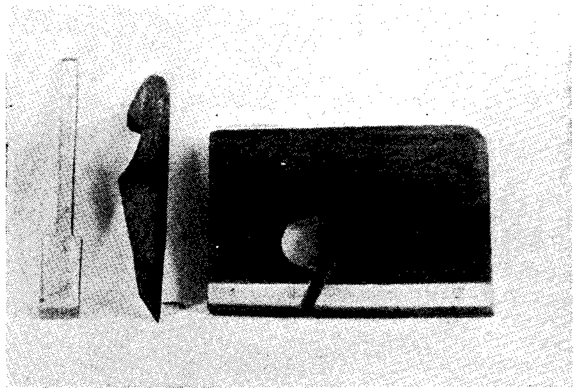


Fig. 121. Another type of small plane, made of beech faced with box-wood.

of the latter, so that it assumes the curved shape shown in the side view in Fig. 122. The drawing in Fig. 124 shows, incidentally, the work at this stage, yet the real purpose of this illustration is to indicate how the end of the upper slot is marked off within the $\frac{5}{8}''$ hole. The marking has been drawn in dotted line, and it will be seen that the position of the slot (*A*) has been drawn through the hole from one face to the other. The width of the slot has also been marked off. The block may now be gripped in the vice, and a $\frac{1}{4}''$ hole drilled from the top to the $\frac{5}{8}''$ hole; taking care that the slope of the drill conforms to that of the markings on the side of the block. You will, of course, not grip the work in the unmerciful jaws of the vice without interposing some cushioning substance between them. Two strips, cut from a 6d. cork bath mat (Woolworth's) make ideal vice

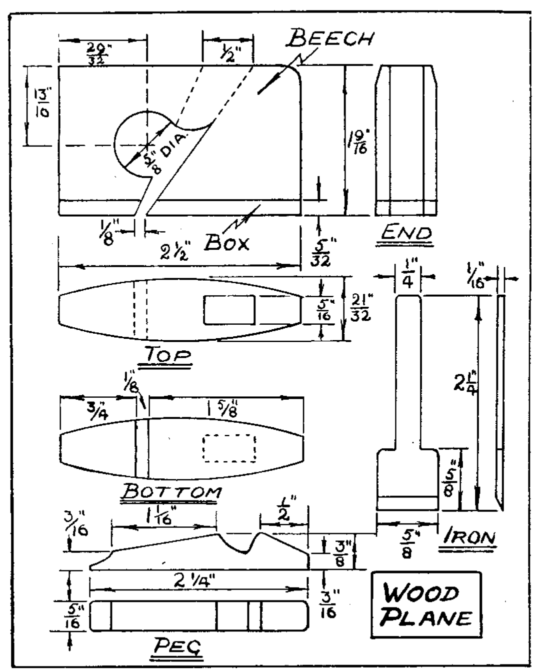


Fig. 122.

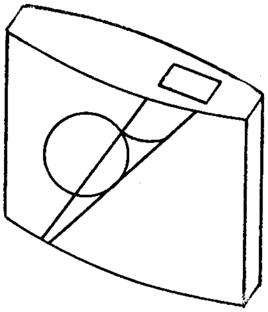


Fig. 123.

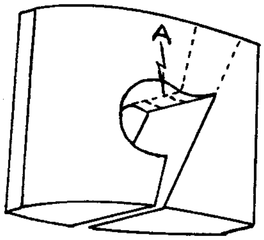


Fig. 124.

cheeks for holding delicate work lightly in the jaws. Now, with a $\frac{1}{4}''$ flat, wood chisel, well sharpened on a fine oilstone, the $\frac{1}{4}''$ hole is squared off, and tapered in accordance with the marking. The square hole will be finished with fine glass-paper stuck on a small, flat strip of wood.

It will be noted that the bottom of the plane has been faced off with box-wood. This is a refinement which adds greatly to the appearance and durability of the tool, but is not a necessity if good, hard teak is selected in the first place. If the body of the plane is of beech, the facing should be used, in which case it should be stuck on with

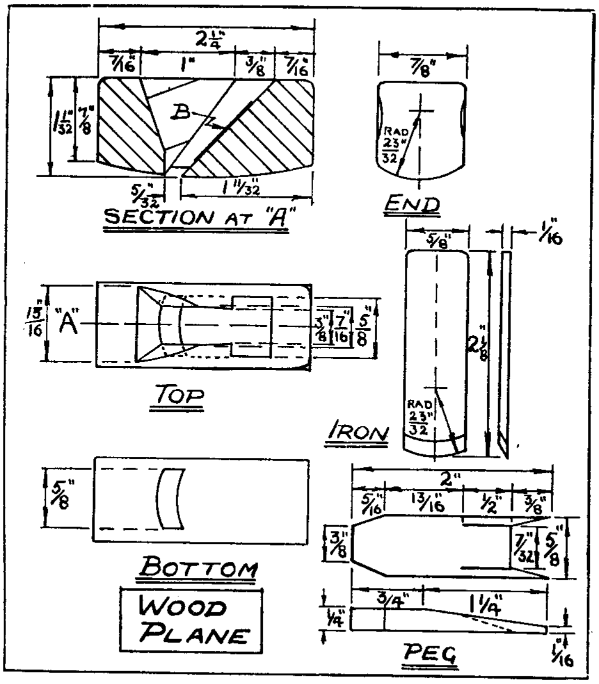


Fig. 125.

thin, hot glue, and clamped until set. The plane should, in any case, be rubbed down with fine glasspaper wrapped around a flat piece of wood to form a rubbing pad. Do use a rubbing pad when sanding, otherwise you are almost certain to round the edges of the working face. The peg or wedge needs little description. It may be cut from teak or box-wood, and is purely a matter of careful work with chisel, pocket-knife and glasspaper. A piece of power-hacksaw blade provides good material for the plane iron. Soften the blade, file it to shape, harden, and temper to a dark straw colour. Finally, grind the cutting edge, and finish on an oilstone.

The plane shown in Figs. 120 and 125 is of more complicated type; the chief difficulty being encountered in cutting out the rather intricate recess for the iron and wedge. The drawing gives dimensions for a very useful size. In the initial stages, the work proceeds as in the first case; that is, the wood is squared off, shaped, and the size and position of the recess marked on the top, bottom and sides. The recess is started by a series of $\frac{1}{8}''$ holes drilled closely together to conform to the angle at which the cutting iron will lie. For

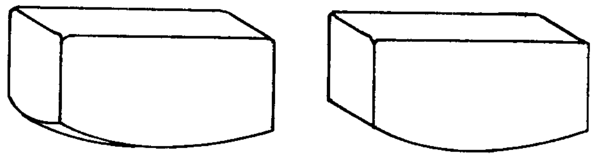


Fig. 126.

the rest, it is then a matter of careful work with the chisel. As a guide to the requirements, I would advise you to remove the iron and wedge from your full-sized plane, so that you may have a guide to the making of your small replica.

If the photograph, Fig. 120, be studied, a kind of rough discolouration will be seen within the recess, upon the sloping portion upon which the plane iron rests when in position. This discoloration is really a piece of fine glasspaper (or what remains of it after some years of use), the purpose of which is to grip the blade firmly when the wedge is driven home. In Fig. 125, this simple friction device is indicated by a thick line at (*B*). This last type of small plane is very suitably made with a rounded working face. Fig. 126 shows some useful arrangements.

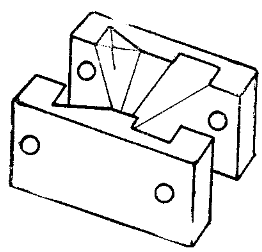


Fig. 127.

Those who do not consider themselves sufficiently familiar with wood carving to attempt the shaping of the recess in one operation, may simplify the job by making the plane in halves. The wooden block should be shaped to the external dimensions, and divided along the line (*A*) in Fig. 125. The block should be made about $\frac{1}{8}''$ wider, however, to allow for the thickness of the dividing cut, and for finishing. Each side of the recess may thus be carved out fairly simply, but care is required to ensure that the halves exactly tally with each other. On completion, the halves are clamped together, and two 3/16″ holes are drilled as shown in Fig. 127. The halves may now be glued together and short lengths of round birch dowling are driven through the 3/16″ holes, and glued in position, to act as keys.

(*To be continued*)

*The History of "Tich Too"

An account, based upon records in the log book, of the development of a miniature flash-steam hydroplane

By H. J. Turpin

Blowlamp

The lamps, during 1939, gave very little trouble, as they are based on the most successful one developed in 1938 for *Tich I*. Fig. 12 shows the twin lamps as first made. Each one consists of a flame tube $1\frac{3}{8}$ dia., $3\frac{1}{2}$ in. long of tin plate on which is wound 50 in. of 5/32 dia. brass tube, one end of which is brazed to the nipple unit and the other to a dual fitting, A, carrying a union for the main petrol pipe.

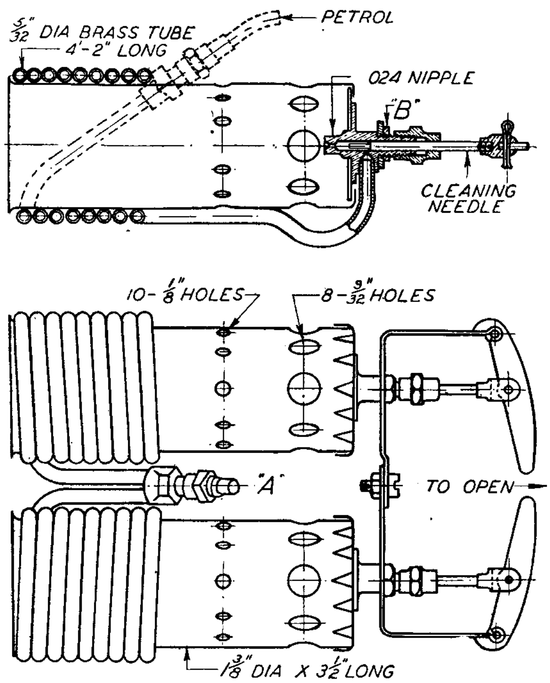


Fig. 12. Original twin blowlamp.

The nipple unit is slightly different from nominal lines. It is made in one piece from bar $\frac{3}{4}$ dia. in order to :—

1. Dispense with separate brass screwed-in nipples which somehow, will always work loose and become enlarged in the hole with continued use of the pricker.
2. Provide a flange that is really square with the nipple for fixing to rear of flame tube.
3. Fit cleaning needles that enter from the rear of the nipple and push out the fouling instead of pushing it in with a pricker.
4. Provide a means of coupling the two lamps and supporting them in the boat, e.g., by a locknut such as shown at B, Fig. 12.

The only tricky part in making the nipple unit is in drilling the jet hole. This is 0.024 dia., No. 73 drill, and is about 0.05 in. long.

When first installed it was intended that the cleaning needles should be used also for starting, no petrol valve being fitted to the tank. I had hoped that the small amount of gas leakage past the needles, when in the nipple hole, would be sufficient to keep a small flame always visible. Once or twice this worked satisfactorily. Unfortunately, in the middle of the pond one day, when preparing for a run, the lamps were heated with methylated spirit, and then, with a few strokes of the pump, the tank pressure was slightly raised. I then proceeded to withdraw the two needles from the nipples simultaneously. These opened suddenly with a jerk and the next I saw was a huge sheet of flame from unvaporised petrol going rapidly skywards. Such warnings are only given once, so the next step was to introduce a petrol control valve as shown in Fig. 13. This, for convenience was fitted at the union A, between the two lamps and carries a 6 B.A. needle valve operating into a hole 0.08 dia. A bracket was erected between the lamps to support the valve. This fitting was excellent and provided a fine means of control.

A later development, however, was the addition of a control for the gas on each burner in order to find out if combustion could be improved. This was done as shown in Fig. 14 by turning the nipple unit upside down and brazing the gas or vaporising tube into the body of a needle valve which, in turn, was brazed into the existing nipple unit. This, too, was a great success, but—and this is the big but—the weight of the two burners had gone up from $8\frac{1}{2}$ oz. to 12 oz., an increase I could ill afford. However, they remained to that design for the remainder of the season, but I took the

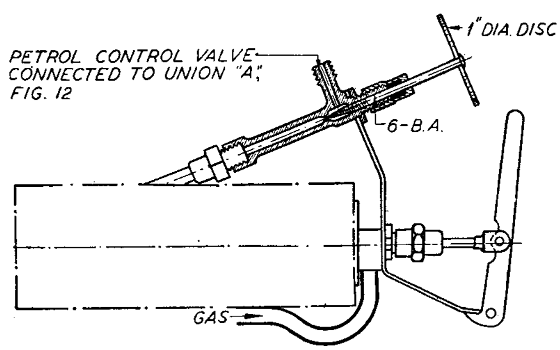


Fig. 13. Addition of needle valve to Fig. 12.

* *Continued from page* 111, "*M.E.*," February 1, 1940.

opportunity last winter to make a new departure in blowlamps for *Tich III.*

The new lamp has a 2 in. dia. flame tube, 3 in. long and, on the bench, gives a flame 10 in. long from flare to tip of cone. It has a needle valve adjustment and weighs 5 oz. I will leave the reader to work that problem out for himself.

Concerning blowlamps, one of the most troublesome things experienced on *Tich I* was that the lamp would keep going for all it was worth when, for instance, the water pump failed, or propeller became fouled with leaves, or for any reason that caused lack of water in the boiler. Several times the boat was recovered from the pond with the boiler tube a vivid shade of pink.

To overcome this on *Tich Too,* I introduced a hydrostatic device by which the static pressure of

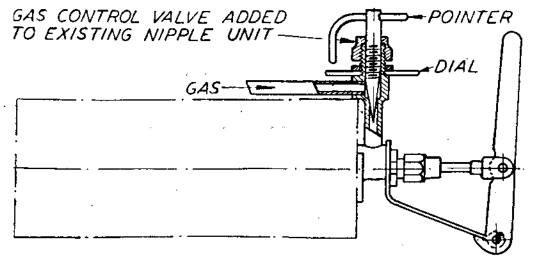


Fig. 14. Addition of gas control to each lamp.

the water on the boiler side of the pump acted, through the medium of a flexible diaphragm, on an air valve in the petrol tank. When water pressure was reduced and the diaphragm relieved of its load, then the air valve opened under the influence of its own spring and also the air pressure in the tank, and so allowed air to escape, thus extinguishing the blowlamps.

This device never failed once throughout the season, and when the story of the water pump is read, the reader will realise that the hydrostatic safety valve was called upon to save the life of the boiler many, many times.

Fig. 15 illustrates this device which, in *Tich Too,* was screwed into a separate air tank in order that a minimum amount of air for compression was always available. In the ordinary petrol tank, when it is almost filled and the air pressure applied, the drop in pressure when petrol becomes used up will almost extinguish the lamps.

One great feature of this hydrostatic device is that the striking lever for stopping the boat need only be connected to a plug cock which releases the water pressure. When this happens the whole heating and circulating systems collapse simultaneously.

Its relative position in the scheme of things is shown in Fig 16, which is not drawn to scale, but arranged to illustrate the relevant parts. Notes attached to the figure make it more or less self-explanatory.

Details of the hydrostatic valve are shown in Fig. 15. Considering the sectional view the parts illustrated from left to right are: 1. Duralumin cap screwed for connection to water supply; 2. Four 6 B.A. fixing screws for cap; 3. Rubber diaphragm $\frac{3}{4}$ dia. ($\frac{1}{2}$ in. effective dia.) $\times$ 1/16 thick; 4. Hardened steel supporting disc 20 gauge thick; 5. Stainless steel valve 0.10 dia., with collar 0.30 dia. 6. Duralumin control nut $\frac{1}{2}''$ dia. $\times$ 16 T.P.I.; 7. Control lever 0.10 dia. screwed into nut and protruding through a helical slot in body; 8. Duralumin body screwed into air tank; 9. Light spring to ensure lift of valve when water pressure is reduced.

In order to enable the air tank to be pumped up on preparing the lamps it is necessary to close the valve by manual operation of the lever which is done by giving it about half a turn. This has the effect of turning the nut down upon the collar of the needle. Immediately before releasing the boat and when lamps are burning and engine running under working pressure, then the last action before release is to withdraw pressure of the nut and allow diaphragm to act.

Like all mechanisms however, it needs a watchful eye to see that the action is not sluggish and is free from grit. The rubber diaphragm needs attention to see that it is always in good condition and replaced at the first sign of deterioration. (I keep a piece of brass tube $\frac{3}{4}$ dia. sharpened at the end to punch out the discs from a motor cycle inner tube.)

As mentioned earlier, this device has not failed throughout the season and I can thoroughly recommend it to other flash-steam boat owners.

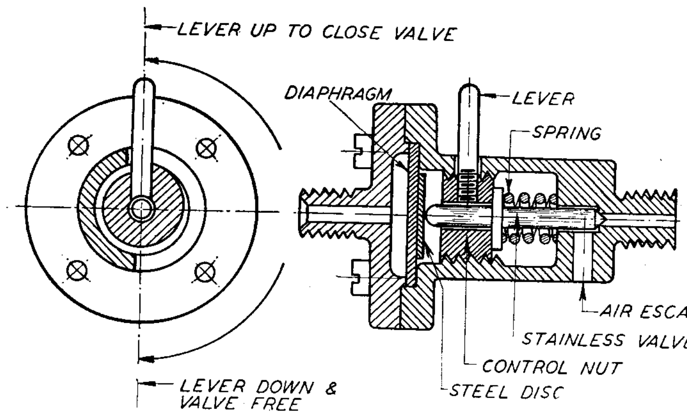


Fig. 15. Hydrostatic air release.

Water Pump

This now brings the story up to the water pump, which is an adventure in itself. The pump and its behaviour occupied my time and ingenuity for the whole of the season. I set out in the first place to put one thing right at a time—and there were many things that *could* be improved in the engine alone—in the process of tuning up, but got no further than the water pump every time.

About the period the design of the pump was being prepared, I came across an aluminium alloy having exceptional physical properties, viz., 15 tons per square inch ultimate tensile and a Brinell hardness of 110 to 130 after heat treatment. It was very little heavier than aluminium, and I decided that I would use it if the necessary castings could be obtained.

This pump is entirely a new departure from that on *Tich I*.

The pump had mushroom valves made from duralumin, because I believe that balls are not a success in a pump working at such a speed—getting on for 1,000 strokes per min. One point is the weight compared with a steel ball: actual weight of duralumin valve 0.50 grammes; actual weight of $\frac{1}{4}$ dia. steel ball 1.3 grammes, both of which would be for use on 3/16 dia. seating.

This reduction in weight, coupled with perfect control, should eliminate misfeeds due to bounce and dither of ball that I suspected last year. The body of the pump is made from the aluminium alloy casting and was extremely light.

Its employment was really an experiment to determine:—1. If it was suitable for valve seatings 3/16 dia. and 0.02 wide. 2. If a stainless steel ram would work satisfactorily in its cylinder. 3. If duralumin was suitable for valves

The boat's first time on the pond was at Brockwell Park, May 8th, 1938, where it did two laps at about 16 m.p.h. and slowed down to 10 m.p.h. for the third and last lap. Week after week went by with the same results—that of falling-off in speed. Early in the season the speed began to get less after the second lap. Later, the trouble developed after the first lap, and continued until the boat would just manage to creep round half a lap at about 12 m.p.h.

Any alteration in stroke of pump or adjustment of blowlamp had no effect on the running.

In order to get to the bottom of the trouble, I then made the following bench test. I rigged up the pump—straight from the pond—on the saddle of the lathe, and drove it at a speed of 1,080 r.p.m., which approximates the speed in the boat.

A measured pint of water was used in each test, the container being placed a few inches below level of suction valve. Length of suction pipe one foot and bore $\frac{1}{8}$ in.—same as diameter of pick-up tube.

Test 1

Pump primed by hand and power pump maintained the flow. On closing delivery pipe with finger, and simulating a slight working pressure, the pump refused to work, the water being pushed back through the suction valve.

On stripping suction valve, seat was found to be dirty and roughened. Valve did not seat properly.

Test 2

Re-assembled pump. Test same as previous one except that a gauze filter was placed in the suction pipe with the result that a slightly higher back pressure to delivery outlet could be applied before valve refused to close.

Test 3

Stripped and cleaned pump. Ground in valves and added a light coil spring to suction valve. This was a great improvement as once the pump was primed and the lathe started, the delivery could not be stopped by finger pressure over delivery outlet.

A measured pint was put in the container and delivered in 1 min. 50 sec. under a continued resistance as strong as I was able to apply with the finger.

This test showed a volumetric efficiency of 88 per cent.

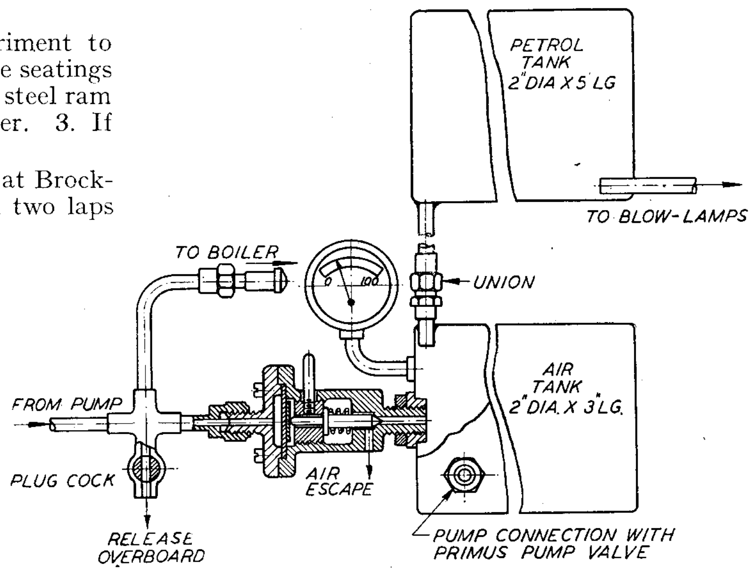


Fig. 16. Application of hydrostatic valve in the air and water systems.

Test 4

As an experiment, I increased spring pressure on suction valve so that it was impossible to lift valve by blowing with the mouth, and tried again. Although difficult to prime, the pump's time of delivery for a measured pint was the same as before—1 min. 50 sec.—and in this test it was impossible to prevent flow by continued hand pressure.

This test taught me many things.

1. That, on the line, the boat stopped after one lap because the rising boiler pressure merely sent the feed-water back through the suction valve.

(I believe that the unloaded suction valve could not close in time because of the momentum of the

water in the suction pipe produced by the suction stroke. It is a water hammer effect on the valve occurring at the moment of reversal of the pump ram. Add to this the effect of the momentum of water produced by the velocity of the boat which —neglecting friction—amounts to the same as the velocity of water through the suction pipe, and I wonder that the valve ever closes at all).

2. That the diameter of the suction pipe—admittedly small—is not the cause of the pump failure.

3. That the failure has nothing to do with the size or shape of surge tank because the pump on this trial worked with filter and surge tank the right way up and also upside down.

On the next try-out on the pond, dated Sept. 18th, the new lamps worked a treat, but nothing else went according to plan. On starting up, the boat did one lap at 25 m.p.h., and gradually fizzled out. On starting up again, the boat did about half a lap and again fizzled out. After that it was impossible to accelerate engine at pond side due to lack of water being delivered to boiler.

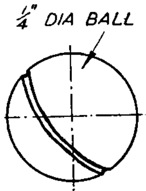


Fig. 18. Illustrating the eroding effect in 24 hours on a steel ball valve when used in an aluminium alloy pump.

It was then decided to try out rubber-faced pump valves. I removed the two duralumin valves, punched out a couple or rubber washers from my tyre repair outfit, threaded them on the valve stems, and assembled the pump.

That alteration was carried out on Monday. On Tuesday morning I worked the pump again, and everything was satisfactory. Wednesday morning, and another working of the pump, only this time it was obvious that the valves were difficult to lift from their seatings, but once removed, the pump functioned well.

Alas ! On Thursday morning the washers were completely stuck, and on dismantling, had to be removed with a knife.

As a last resource, I then decided to revert to ball valves. I set each part of the pump in the lathe, and machined new flat seatings over the existing 3/16 in. dia. holes. To finish the seatings, I set up a ball in the self-centring chuck and pressed the pump seating on to it (while running) with a little lubricating oil between. The result was a beautiful seating about 0.01 wide.

The next trial was on Sunday, Oct. 2nd, at Victoria Park. Rain was coming down hard, and I had to wait until it eased off a little, all the time itching to get the modified pump going.

With the assistance of Mr. Cockman (better known as *Ifit*), I got the pole set up, then brought the boat out and lit up the lamps. A few strokes of the priming pump were put into the boiler, and the engine just ticked over. Yes, just ticked over, and no amount of pumping would coax it to rev. any more.

Recognising the symptoms as the oft-repeated ones of weeks and weeks past, I knew that my day's work was done. The more I pumped the less the engine turned.

The diagnosis of the pump trouble was simple and obvious, for Fig. 18 will convey what happened to the balls while they had been resting in the new pump seatings for only 24 hours.

By electrolitic action, a ring 3/16 dia. had been eroded around the ball sufficiently deep to check one's thumbnail.

To be continued

How to Erect the Cylinders for the "Bat"

(*Continued from page* 159)

holes. Now adjust the position of cylinder until the front edge of the block is 1 7/16" from the front edge of the frame, and the cylinder horizontal, with the extended piston rod dead in line with the middle of the driving axle. In this position, the top of the steam chest should be approximately 3/32" below the top edge of the frame.

Poke a No. 30 drill, in the hand brace, through the screw holes in both frames, and make countersinks on the bolting face of the cylinder. Remove, drill No. 40 and tap 1/8" or 5 BA. Repeat the operation with second cylinder, then attach both assemblies by either hex-headed screws, or studs and nuts.

Slide the guide yoke along the bars until it is 1 1/4" from the cylinder block, and exactly vertical; then attach it to the frames, either by 1/16" or 10 BA screws entering tapped holes in frame, or by same size screws through clearing holes in frame, drilled through those already in the yoke flange, and nutted inside frame.

Turn the wheels until the crank is on front dead centre ; this will probably bump the piston against the front cover, and force the rod well into the crosshead boss. Make a little mark on the piston rod, 1/64" away from the crosshead boss. Take off the front cover, and tap the piston until the little mark just comes flush with the crosshead boss. This sets the necessary clearance both ends, and the crossheads can be pinned to the rods by drilling a No. 55 hole clean through boss and rod, and forcing in a pin made from steel wire. Replace covers. The wheels should now turn freely, with no trace of bind or tight places on either cylinders, guides and crossheads, or rods. Always bear in mind, especially with these weeny power units, that you want the "Sunny Jim" delivered at the draw hook, and not frittered away in moving badly-fitted working parts. Valve gear next.

Model Engineers and National Service

* Capstan and turret lathes

By Edgar T. Westbury

IT is also possible to deal with short lengths of bar of a diameter up to about double the through capacity of the mandrel, by using a special form of "dead-length" collet chuck, as shown in Fig. 21. This is designed so that it can be fitted to the standard type of chuck.

In addition to the usual type of spring collet, which will only grip bars of a size within fairly close limits of its bore, the chuck can be fitted with section pads, which are similar to the jaws of a drill chuck, and allow of a much wider range of adjustment. Specially shaped section pads are also available to deal with bars of other than round section, as shown in Fig. 22. For rough black steel bars, or cast bars of iron or bronze, even of round section, the use of section pads is to be recommended, as they accommodate themselves better to surface irregularities than spring collets, and three gripping points are preferable to four in this respect. Spring collets should, however, always be used for bright drawn or extruded bars in which concentricity is important, as this type of chuck is the only one which can be relied upon to maintain exact truth under working conditions. Most types of collet chucks are adaptable to either hand or pneumatic operation, an example of the latter being shown in Fig. 23.

For dealing with castings, forgings and sawn bars of large diameter in relation to their length, both three-and four-jaw chucks are extensively used, but the latter are not popular for rapid quantity production, owing to the time taken to set the work up in them. The self-centring chuck is preferred for such work, but it is often adapted to deal with work of irregular shape by means of false jaws, or by making the standard jaws of the chuck in two sections, bolted together with a serrated joint, so that the outer or actual jaw section can be adjusted relatively to the base section which engages the scroll.

Chucks thus equipped can also be fitted with soft jaws, which are machined to suit the work to be dealt with, thus increasing the gripping area and ensuring true concentricity, irrespective of the condition of the chuck itself. It is necessary, when machining the chuck jaws in this way, to lock them against backlash by means of a jaw locking ring or an extemporised device of a similar nature, and for short work which is to be gripped either internally or externally over or in the steps of the chuck, it is an advantage to undercut the latter slightly, in order to introduce a tendency to pull the work back firmly against the face of the jaws.

Air-operated jaw chucks are not fitted with a scroll, but each jaw is equipped, as shown in Fig. 24, with a bell crank lever, the inner end of which engages a groove in a central sliding member, connected by a bar or tube to the piston of the compressed air cylinder, which is concentrically mounted on the tail end of the mandrel. The air service pipes for opening and closing the

* *Continued from page* 131, "*M.E.*," *February* 8, 1940.

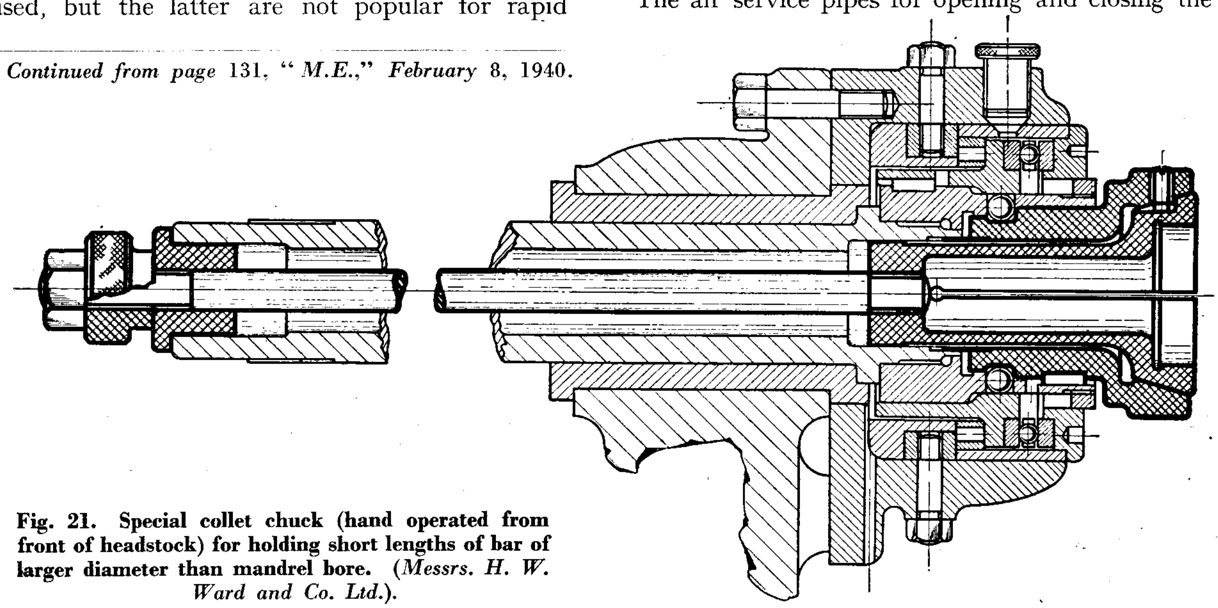


Fig. 21. Special collet chuck (hand operated from front of headstock) for holding short lengths of bar of larger diameter than mandrel bore. (*Messrs. H. W. Ward and Co. Ltd.*).

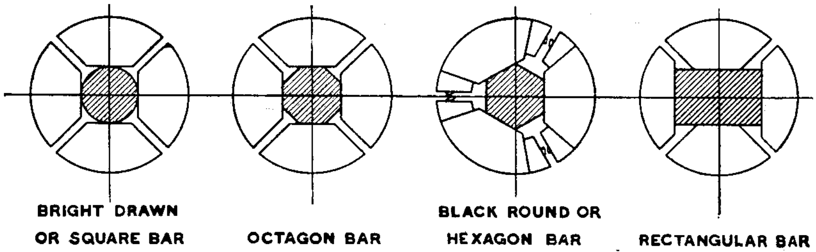


Fig. 22. Section pads for dealing with various sections of bar in collet chucks.

chuck are brought in to the rotary cylinder through a swivel fitting. The gripping force exerted by a pneumatic chuck depends entirely upon the diameter of the piston, and the air pressure at which it operates. Thus, the grip is always exactly constant, provided that an even pressure is maintained in the supply line, and it is impossible to distort the work or strain the jaws by using too much force. In the case of delicate or fragile work which calls for light chucking, the pressure may be lowered by a reducing valve in the air line.

Some types of chucks are so devised that, having once been tightened, they are not affected by leakage or even complete failure of the air supply, the pistons being locked so as to be irreversible until air is admitted to the opening side. The advantages of this provision are obvious, as, in its absence, the bursting of an air main might result in the work flying out of the chucks of all the lathes connected to it.

Special Chucking Fixtures

The use of special jigs to hold work of awkward shapes is very common in capstan and turret lathe practice, and the ingenuity of the toolmaker is constantly in demand to devise and make such fixtures. Bell chucks and box jigs of various types, and jigs based on the principle of the angle-plate, for locating from a right-angled machined face, are among the most popular of these, and the accompanying photograph shows an indexing jig attached to an angle plate fixture, so that the three bores of the component can be successively brought into line for machining, at exactly 120° to each other.

Another angle plate chucking fixture, embodying methods of location and operation which are well known in machining jig and fixture practice, is shown in the next photograph. In this case the component to be machined is a small crankcase casting, which is bored and faced at one setting. It is located from the previously machined bottom

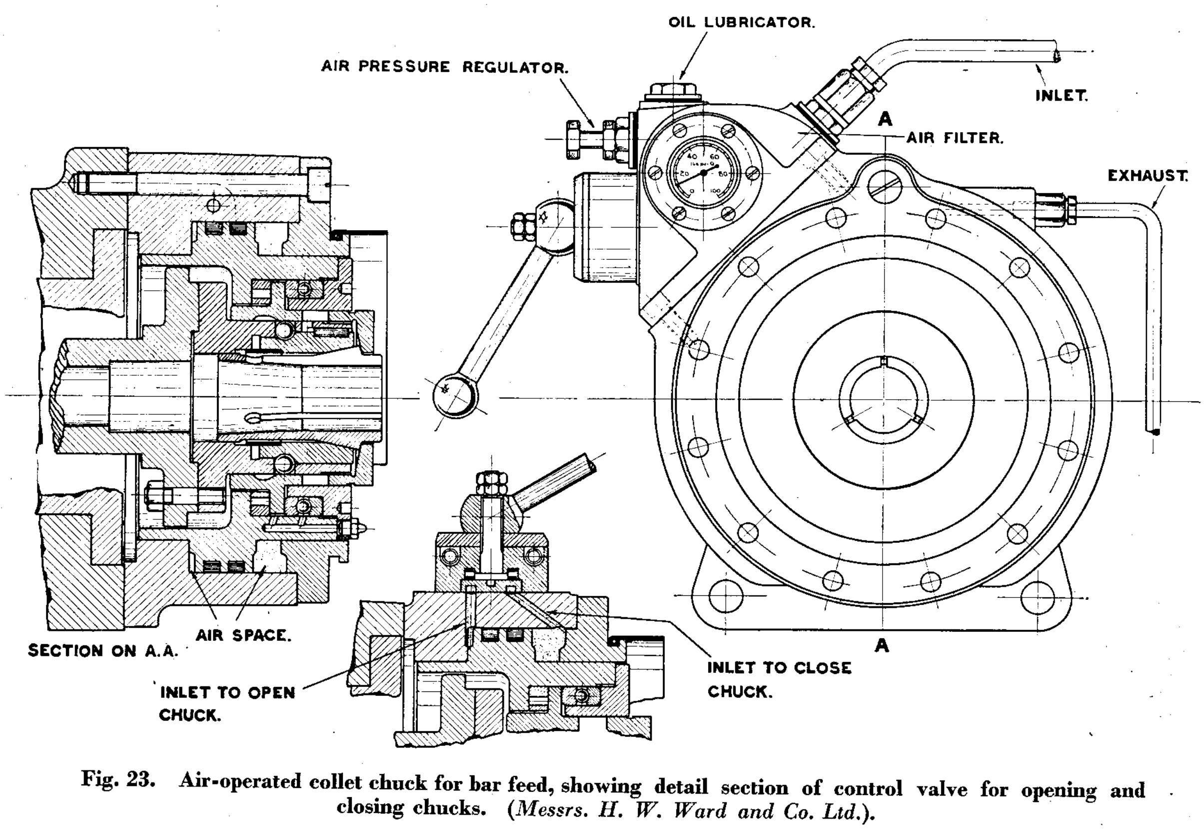


Fig. 23. Air-operated collet chuck for bar feed, showing detail section of control valve for opening and closing chucks. (*Messrs. H. W. Ward and Co. Ltd.*).

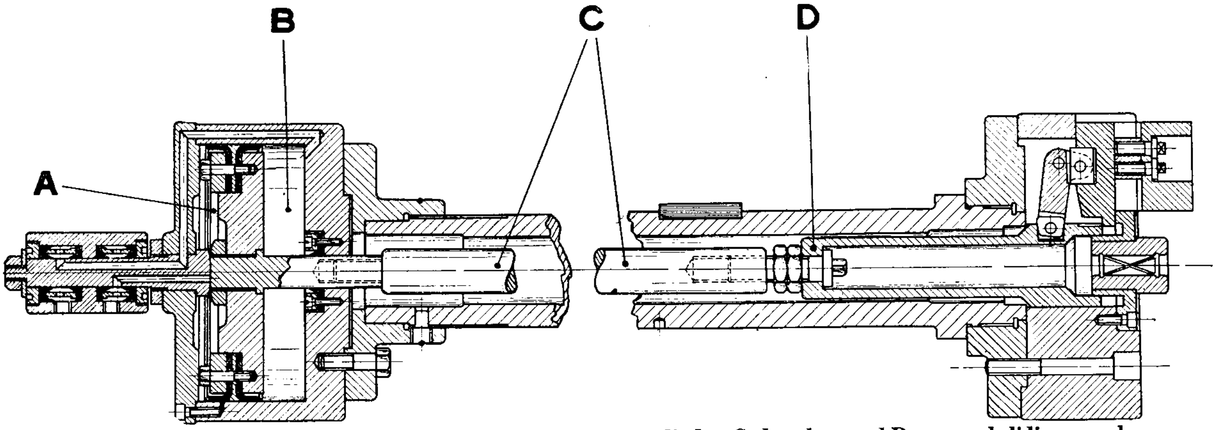
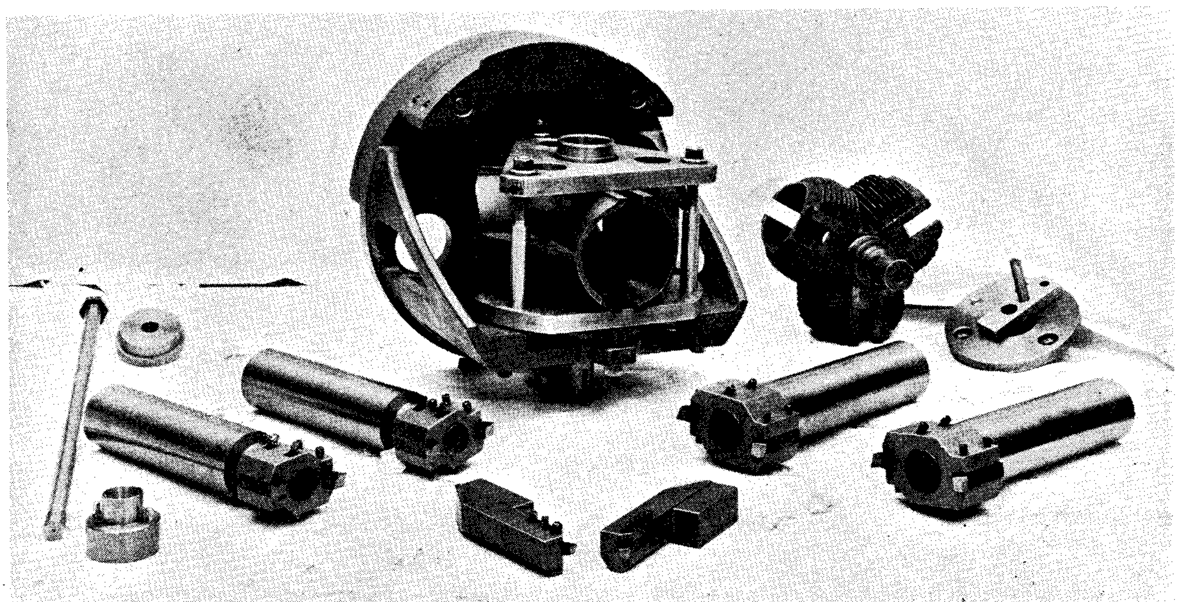


Fig. 24. Air-operated jaw chuck, showing : A, piston, B, cylinder, C. drawbar, and D, grooved sliding member actuating bell cranks of chuck jaws.

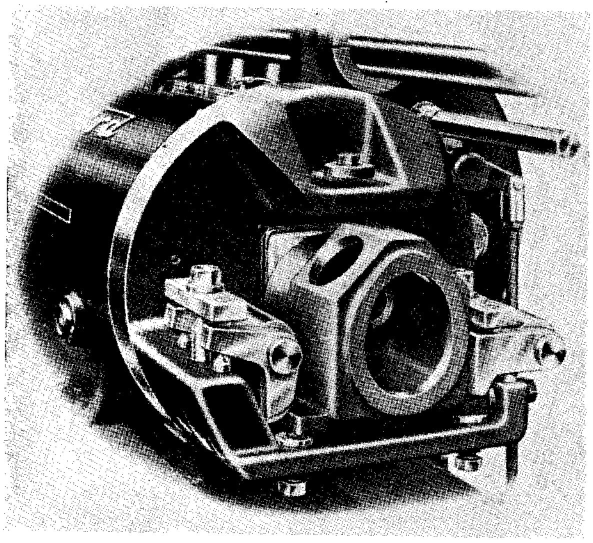
face, four adjustable studs being fitted to the platform of the fixture to allow of initial setting, while two similar studs are fitted to the side to locate the edge of the casting. The straps which clamp the work down do not bear directly upon it but act through pivoted fingers which bear directly over the studs, and it will be noted that one pair of fingers is arranged to provide a sideways wedging action which forces the work against the side locating studs, so that accurate and positive location in both planes is ensured. It will also be noted that the fixture is designed so as to avoid the necessity for using loose clamps or other detachable parts which would increase difficulty or waste time in operation.

Many chucking fixtures in large quantity production are made so as to be capable of operation by the pneumatic gear used for collet or jaw chucks. A common type of such device is that used for "second process" work on components which have already been part machined, and can be located from either internal or external registering surfaces. In such cases, the chuck proper consist of a faceplate fixture carrying the necessary spigots, or bungs, as they are often termed, and the actuating gear is simply one or more draw straps which pull the work back against the faceplate. When the component is very deep, and where the preliminary machining allows, it is usual to extend the cylindrical locating surfaces as far as possible so that the rigidity of support at the outer end is improved.

In many cases it is possible to utilise the jaw chuck itself as a special chucking fixture by adjusting or machining the jaws to conform to the shape of the component to be held. Some castings and forgings may be handled by means of a chuck having only one movable jaw, the



An indexing chucking fixture for machining a component having three branches at 120 degrees, showing tool equipment used on same. A smaller, finned component which can also be dealt with in this jig is shown to the right of it. (*Messrs. H. W. Ward and Co. Ltd.*).



An angle plate chucking fixture for holding a crank-case casting.

others being pre-set so as to properly locate the work, and then locked firmly in position. An advantage of this method is that if the work is irregularly-shaped, the usual equidistant jaws may not be readily adaptable to fit up to it, but the temporary fixed locating jaws may be bolted to the chuck face in any position, and any desired number of them may be used.

Symmetrical components, on the other hand, are generally handled best by means of a chucking fixture having two or more operating jaws. A

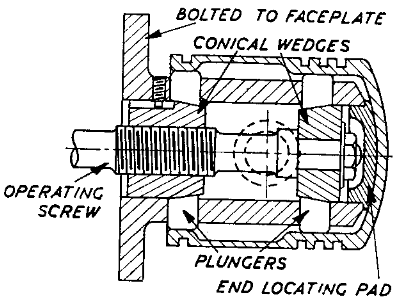
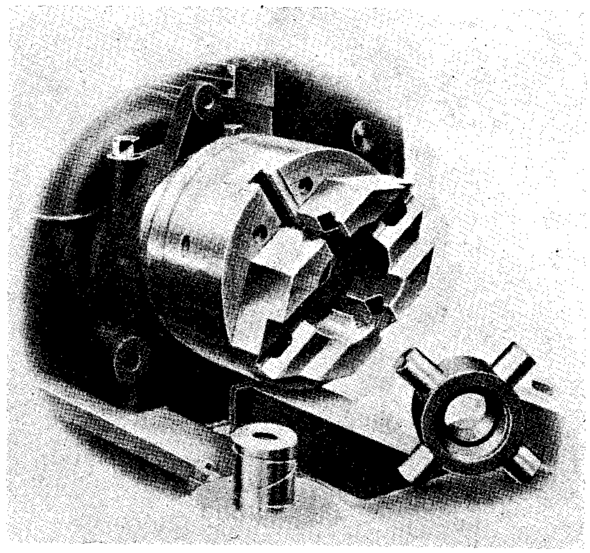


Fig. 25. Chucking fixture for finishing pistons.

fixture of this type, adapted to an air-operated jaw chuck, for holding a four-armed forging, is shown herewith. Two jaws are employed, and in addition to being machined internally to fit the hub of the component, they are vee-grooved to grip two of the arms, while the other two are accommodated in grooves across the face of the jaws.

Special chucking fixtures include expanding or contracting devices for holding part-finished work for final operations. An example of such a fixture is the piston chuck shown in Fig. 25, which is extensively used for finishing pistons, after they have been rough-machined internally and externally, and gudgeon-pin holes bored. In principle, it amounts practically to a form of



A two-jaw air-operated chuck adapted to hold a four-armed differential spider, seen on right.

expanding mandrel, having two sets of plungers or jaws, which are forced outwards by the endwise motion of conical wedges, so as to grip the inside of the piston at two lateral positions, near the skirt and near the crown respectively.

This form of jig would not be suitable for dealing with cast pistons which are left rough over most of the interior surface, and in this case it is usual to employ a form of jig which clamps the piston to a true-running face by endwise pressure, as in faceplate mounting. The method of clamping is by a draw-bar acting upon an internal block which is drilled transversely to take a cross-pin inserted through the gudgeon-pin holes. In some cases, a tilting or collapsible cross-member is used to make the device self-contained and avoid the use of loose pieces, thus speeding up operation. As most pistons can be machined

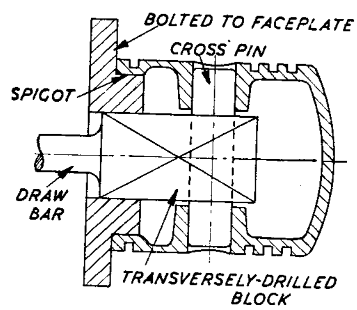


Fig. 26. Faceplate chucking fixture for finishing pistons which are not machined all over the inside.

inside the end of the skirt during preliminary operations, it is generally possible to provide the "faceplate" with a spigot to fit this bore, as shown in Fig. 26, thus automatically centring the piston for the final sizing cut, which is, in many cases, taken with a diamond tool.

(To be continued)

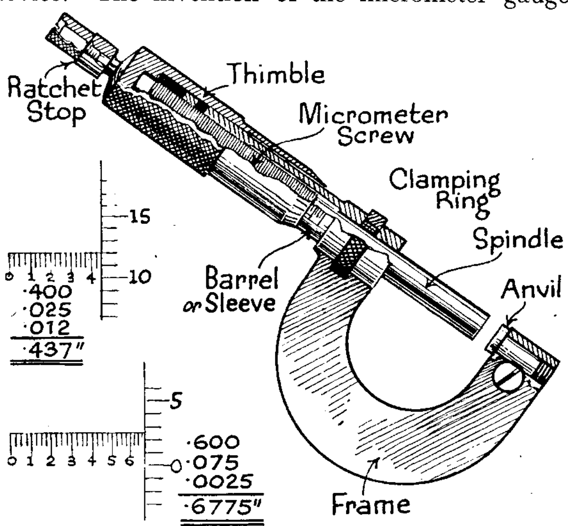
*Gauges and Gauging

A series of great value to engineers of all classes, particularly those who are engaged upon national service

By R. Barnard Way

OUR previous remarks on the subject of the caliper gauge inevitably lead up to that of the micrometer and measuring machine, though this latter is not due for mention just yet. So, before passing on to further study of the methods of special limit gauging, we will complete our examination of the tools that make the measurements possible.

It is a remarkable, but little known fact, that the vernier was invented as long ago as 1631; the inventor was a Frenchman (or was he Swiss?) by name Pierre Vernier, hence the name of the device. The invention of the micrometer gauge



The micrometer caliper.

is much more recent, and this also came from France, in 1848, though its development is probably due to the then newly-formed partnership of J. R. Brown and L. Sharpe in the U.S.A. "Brown & Sharpe" as a trade name needs no introduction, or further comment, from the present writer or any other.

The simple form of micrometer caliper, capable of being read to a degree of accuracy limited to the one-thousandth of an inch, does not need a vernier, being dependent upon the movement of a very accurately made screw in a fixed nut. This fixed nut is one leg of a horse-shoe, or U-shaped frame, the other leg forms the block or anvil against which the measurement is made. Screwing up the spindle moves it forward towards this anvil, and *vice versa*.

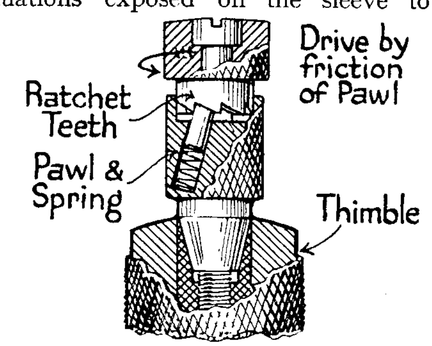
* *Continued from page* 118, "*M.E.*," *February* 1, 1940.

Here is a drawing and sectional diagram to illustrate the working parts of a typical micrometer gauge, giving also the customary names applied to those parts. The fixed nut to which we referred is properly called the Barrel or Sleeve, and in it runs the screwed portion of the Spindle, the forward extension of this is finished smooth, and its outer end forms the movable measuring surface together with the fixed surface of the Anvil. Fixed to the spindle is the Thimble, bearing a series of 25 graduations around a bevelled portion at its inner end. The other end is knurled for a firm grip. The part of the sleeve that is uncovered by the thimble as that is unscrewed is graduated to record the number of turns made by the thimble.

The invariable practice is to make the spindle with a thread of 40 to the inch—we refer now to the English system, for with the Metric system the pitch is $\frac{1}{2}$ millimetre, approximately 50 threads to the inch. This means that the graduations on the sleeve will be at a spacing of 1/40″, or .025″, and these will be accentuated at every fourth stroke and numbered to show tenths of an inch.

The reason for the graduation of the thimble into 25 parts should be now clear, for as the rotation through one complete turn represents 1/40″, then the rotation by one division represents $1/40 \times 1/25$ or 1/1,000″.

This sounds clear enough, but it needs quite a fair amount of practice to read off thousandths with speed and precision. Suppose that the graduations exposed on the sleeve total four

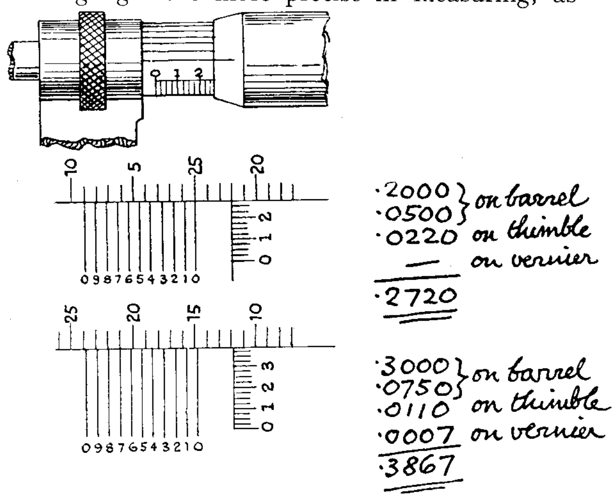


An enlargement to show details of a ratchet stop.

whole tenths and one whole fortieth, and the thimble twelve. What do you make of that? Four tenths mean 0.400″, one fortieth beyond adds 0.025″, and the twelve divisions on the thimble represent a further advance of 0.012″. So our total becomes 0.437″. The skilled man can, with a micrometer in good order, estimate a

further decimal place by carefully noting the position of the zero line with regard to the two nearest graduations on the spindle. "Half a thou." is quite legitimate by this means, but it would be unwise to go beyond this perhaps.

Our sketches show one or two settings with the solutions, but for fuller details on this subject we shall have to refer our readers to the very useful handbook in THE MODEL ENGINEER series. We ought, however, to mention an important detail with regard to micrometers for metric measurements. The pitch of the screw is ½ millimetre, but the graduations on the sleeve show whole millimetres, as a rule these being grouped in fives. The thimble is graduated into 50 parts, but as it has to be turned twice to advance it by one millimetre, this sleeve scale needs watching and reading carefully, otherwise you may well get the answer wrong by half a millimetre. Metric micrometer gauges are more precise in measuring, as



The vernier on a micrometer gauge permits measurement to the ten thousandth part of an inch, with precision.

they will read to the hundredth part of a millimetre, equal in inches to almost four ten-thousandths (0.0004″).

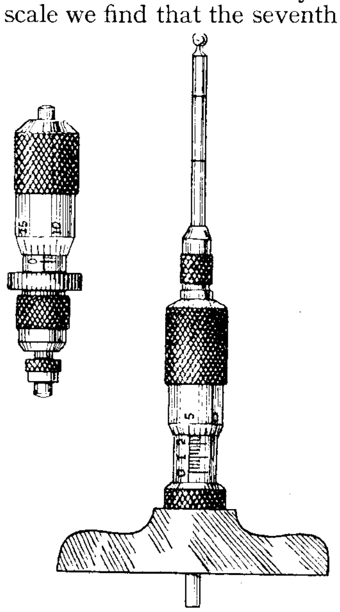
It can be imagined that with a fine thread screw to compress the object being measured, there may be some risk of screwing up the spindle unduly tightly. There is a point at which true contact is made and at which an exact measurement would be recorded, but it is possible to screw up tighter than this, so getting a measurement short of the correct one. That this is a serious risk is realised by the makers of these tools, most of whom provide some device to put the thimble out of action as soon as sufficient pressure has been put on the measuring points. A familiar one is the Ratchet Stop, a free-wheel sort of arrangement in an extension of the thimble. The spring controlling the pawl is a stiff one, so that it holds and drives while the thimble is being screwed up, but just as soon as the measuring pressure is reached the spring gives and refuses to drive further.

When screwing out, the drive is positive. To bring the ratchet stop device into action the small diameter extension has to be used, and not the thimble, but this is an advantage where quick measurements have to be taken, as it can be twirled quickly between finger and thumb.

Introducing a vernier on the micrometer gauge makes measurements possible to ten-thousandths of an inch. The vernier scale is engraved on the barrel and consists of ten divisions occupying the same space as nine on the thimble scale. The argument about this is on the same lines as that for the sliding vernier; one division on the vernier scale represents a movement of $1/10 \times 9/1{,}000$ or 0.0009″, and one division on the thimble scale represents $1/1{,}000$ or 0.0010″. The difference between these two amounts to 0.0001″, or $1/10{,}000$. Two examples of readings are shown, and for clearness we have straightened out the scales.

In the first example, we read on the barrel three tenths and two fortieths, making a total there of 0.3500″. Turning to the thimble we see the zero line to be truly in line with the sixth graduation, and reference to the vernier scale checks this, for both the 0 and 10 lines are coincident with lines on the thimble. So the total in this case is 0.3560″.

In the next case, the figures are the same for the first three decimal places, but this time there is clearly some addition to make, so by referring to the vernier scale we find that the seventh line is the



An internal gauge and a depth gauge of micrometer type.

one that is truly coincident with one on the thimble. This indicates that the thimble had moved seven ten-thousandths on, and our total becomes 0.3567″.

Just as with everything else, reading the vernier micrometer is a matter of practice, there is nothing in it in reality. It is a tool that the limit gauge

maker could hardly do without, its uses crop up everywhere in the tool-room, and everywhere else where careful measurements have to be taken. They are made in hundreds of different styles and sizes, a very useful form is the wide gap type, enabling lengths of anything between 0 and 12 inches to be dealt with, or, alternatively, 12 to 24 inches. This is done by providing several changeable anvils of varying lengths.

There seems to be some danger of developing into a toolmaker's catalogue here, so we had better pass on to some more practical details. Before doing so, we cannot omit mention of the inside type of micrometer, of which there are two sorts. The first has sliding jaws, something like those of the caliper square, but the other is quite a different affair, and looks like the business end of a micrometer caliper come adrift. With a set of measuring rods of different sizes, such a tool makes a useful addition to the gear, though even the smallest one cannot deal with any inside measurement less than one inch.

Finally, we have a micrometer depth gauge, with a long rod enabling depths to $2\frac{1}{2}''$ to be measured, correct to the nearest thousandth. The rod has deeply engraved graduations at half-inch intervals, and these are held by accurate clamps, so that extensions of half an inch at a time can be made. The micrometer scale can gauge half an inch.

We must next pass on to the use of indicating gauges for testing the accuracy of workmanship.

(To be continued)

Hints and Gadgets

Short original and practical contributions to this page are invited from readers, and will be paid for. Write on one side of the paper only; address items to the Editor of THE MODEL ENGINEER, *and mark envelopes " Workshop Hints."*

Levelling Worn Oil-Stones

Oil-stones, after long periods of use, become hollow in places and, in general, uneven. Grinding the worn oil stone on an emery wheel is not good practice, as it glazes the surface and destroys the cutting qualities of the oil-stone. One very good method to level an uneven stone is to fix an old 10 in. or 12 in. bastard file on the workbench, pour on it a small quantity of paraffin oil, and add some coarse abrasive. Then, well rub the oil-stone backwards and forwards over the file with a slight pressure until the surface of the stone is levelled.

Another good method for truing uneven oil-stones is to obtain a cast-iron or steel plate which has a perfectly smooth surface, and then sprinkle it with either a No. 80 or 90 abrasive. The worn or uneven oil-stone can be made level by rubbing it over the metal plate and applying the abrasive as required.

Obviously, if the user will be more thoughtful and use his oil-stone so that it will be worn down toward the ends at about the same rate as the central portion, it will be found to last very much longer before re-truing is necessary.—A.J.T.E.

A Tip to Prevent Tool Chatter.

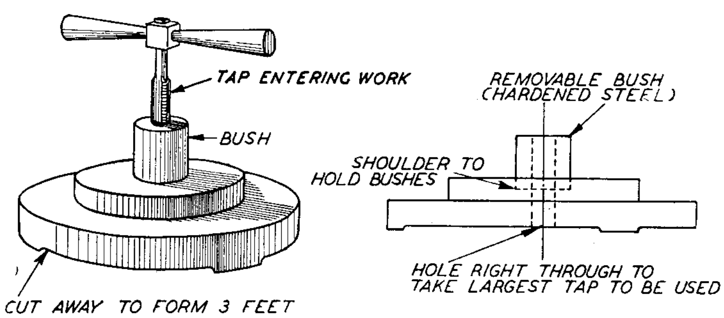
It sometimes happens that lathe tools have to be set out farther from the tool-holder than is good for them, from the point of view of chatter.

This chatter can often be over come by placing a piece of cardboard, or leather, between the tool and the holder before tightening up.—R. N. J. EDMONDS.

A Tap Guide

It is often very difficult to start a hand-tap truly vertical, and generally the smaller the tap the greater the problem. Here is a little gadget which, though easily made from scrap, holds the tap vertical till it has entered the work sufficiently to preserve its own accuracy.

A base-plate is turned up in cast-iron, or even brass, and a series of interchangeable bushes of hardened steel are made to drop into it. The bottom of the flange-plate may, if desired, be slotted out to leave but three feet, for greater accuracy of seating.



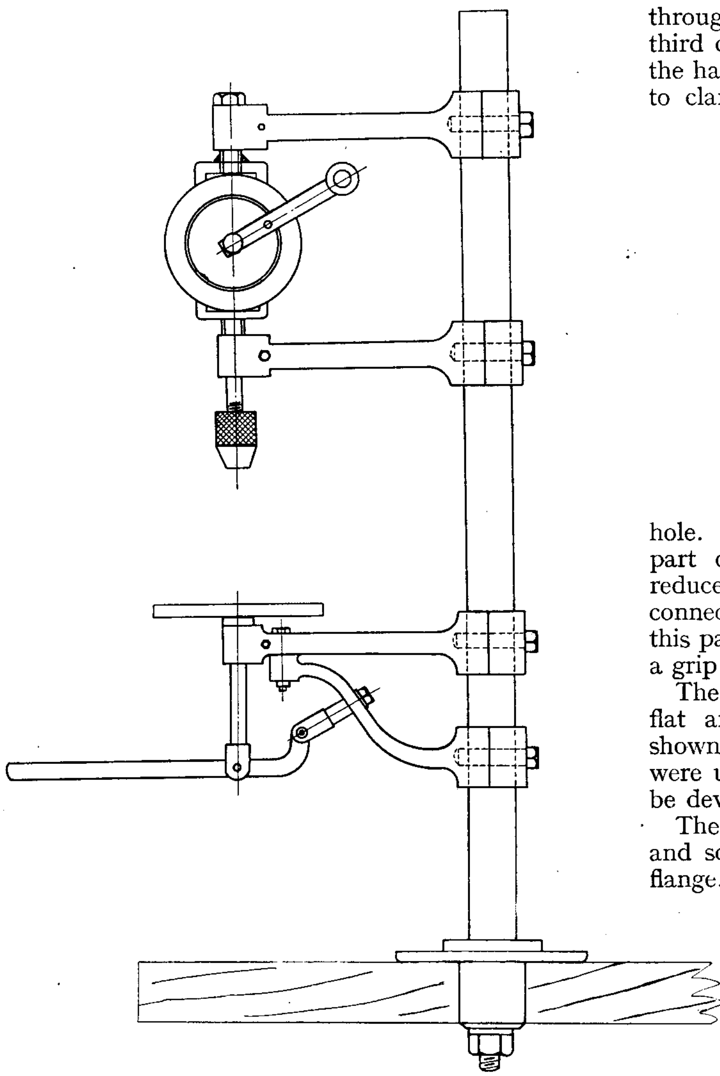
In use, the flange is held hard down over the hole being tapped, and is removed when the thread is started. The guide is especially useful when using " intermediate " and " butt " taps.—F.C.

Drilling Machine from Scrap

By Roland H. Hill

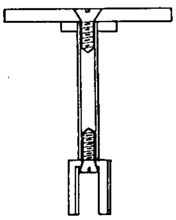
THE drilling machine shown in the drawing was rigged up from scrap material lying about the garage, with the exception of the hand drill which cost 4s. 6d.

The column and base are a scrap axle and hub off an old Morris car. The arms are a scrap set of "Austin 7" connecting-rods. Such parts are cheaply obtainable at any car breaker's yard. The table is a piece of $\frac{3}{8}''$ steel plate—any scrap cast or steel blank will do, of course. The table stem on my drill is an old type "Austin 7" greasing extension, as used for the universal joint. Such parts are not essential so long as the stem is a good sliding fit in the gudgeon-pin hole. The brake-rod fork at the bottom has no pin in it for three reasons:—(1) To allow the handle to fit further into the fork; (2) to prevent the table twisting round; (3) to allow the handle to drop down out of the way when not in use.



Elevation of the drilling machine built up from scrap.

The bottom connecting-rod was put in the workshop stove and cranked. Final bending was done cold, and the gudgeon-pin hole bolted through a hole drilled near the little-end of the third connecting-rod. The handles were taken off the hand drill and a hexagon bolt used in the top to clamp the frame up to the top gudgeon-pin hole. The side handle is discarded. The lower part of the drill frame (near the chuck) was reduced to a tight fit in the end of the second connecting-rod. The gudgeon setscrew clamps this part. The big-ends needed tin packing to get a grip on the column.



The table and stem in detail.

The lifting handle is a piece of $\frac{3}{8}''$ rod hammered flat and drilled for the anchor-pin. The table shown in section shows how countersunk screws were used to build it up. Any other means can be devised as required.

The hub base is merely sunk in the bench top and screws put through three holes in the large flange. The taper end of the shaft in the hub is not screwed tight. This allows the column to be perfectly firm and yet can be swung round to any position, or even with the nut removed the whole assembly can be lifted out and hung up away from the bench.

The drill is very rigid, and has been a very useful effort for light work.

Queries and Replies

Enquiries from readers, either on technical matters directly connected with model engineering, or referring to supplies or trade services, are dealt with in this department. Each letter must be accompanied by a coupon from the current issue, with a stamped addressed envelope, and addressed: "Queries and Service," THE MODEL ENGINEER, 60, Kingsway, London, W.C.2.

Queries of a practical character, within the scope of this journal, and capable of being dealt with in a brief reply, will be answered free of charge.

More involved technical queries, requiring special investigation or research, will be dealt with according to their merits, in respect of their general interest to readers, such as by a short explanatory article in an early issue. In some cases, the letters may be published, inviting the assistance of other readers.

In cases where the technical information required involves the services of a specialist, or outside consultant, a fee will be charged depending upon the time and trouble involved. The amount estimated will be quoted before dealing with the query.

Only one general subject can be dealt with in a single query: but subdivision of its details into not more than five separate questions is permissible. In no case can purely hypothetical queries, such as examination questions, be considered as within the scope of this service.

7,741.—Tipped Lathe Tools—W.T.B. (Nigeria)

Q.—I should be obliged if you would inform me whether small lathe tools, say 5/16" or ⅜" square shanks (or cutter bits, round or square, for small toolholders), can be obtained tipped with "Widia," "Rennite" or similar hard substances.

Is it a fact that such tools require a special grinding wheel for sharpening?

A.—"Wimet" tipped tools are only supplied down to ⅜" square shanks in a few patterns, and only down to ½" square in others. Some parting tools, however, are supplied with shanks ⅛" × 1", 3/16" × 1", ¼" × 1¼", 5/16" × 1", and so on, but the 1" depth takes the inset cutter. It appears not possible to inset cutters (tips) in anything less than ⅜" or ½". Whether it is possible to use cutter bits made entirely in the hard material so that they are strong enough to resist fracture we do not know.

"Wimet" needs special quality grinding wheels, and separate qualities for rough grinding and finishing. The grinding must be done wet.

7,738.—Self-Winding Wrist Watches—W.G. (Liverpool)

Q.—Can you inform me how the self-winding wrist watch, which is on the market, works? Is there a book explaining same?

A.—There are many inventions of wrist watches fitted with self-winding gear; most of which take action from the swing of the arm. Of those on the market, there are five kinds, of which four are operated by pendulum action of a weight, and one by the muscular movement of the wrist. Two of the first four have the pendulum in the form of a weight on an arm pivoted concentrically with the dial, and upon a ¼-plate, which houses the reduction gear train. The final wheel of the train, which is driven by a pawl action on a centre wheel, drives directly on to the winding wheel of the movement. There is a stop pawl on the second wheel, and, in one case, an extra stop pawl on the winding wheel, so that the whole of the self-wind can be removed and inspected without letting down the spring. The pendulum action centre is on the 9-3 line of the watch dial, with the weight on the 3 side, and the latter swings in a rotary direction between spring buffers. These watches are described as having the set-hand gear operated from the bezel moved in either direction. A contrate gear in the rim of the bezel drives a wheel on a radial shaft. This shaft, by a projecting pin, pushes down a castle pinion into gear with the set-hand wheel, and then revolves it either way.

The other two of the first four have, for their moving weight, the watch movement itself, which either swings between a pair of curved arms suspended from a bar fixed to the case, or slides in a frame running upon fine seed balls in a groove on each side of the case. In both cases, the reduction gear goes with the movement to keep gear with its winding wheel. These watches have a separate button for the set-hand gear.

The fifth watch relies for its action upon the muscular movement expanding or contracting the bracelet or strap. One strap end is on a fixed cross-bar on the case, the other end is upon a similar bar on a rocking shaft which pushes in the winding rod or lever to operate the wind. These watches have a supplementary lever on the movement, which, when out of the case, can be wound by rocking the lever. These again have a separate button for hand setting.

Some detail and handy reference to methods of repairing these watches are given in "Modern Watch Repairing and Adjusting," by T. R. Robinson, obtainable from our Publishing Department.

7,719.—Winding a 30-cycle Induction Motor—W.A. (Shirebrook)

Q.—I have an electric motor; it is an English Electric, but I do not know the h.p., for the plate was missing. It is a squirrel-cage induction motor. Outside diameter of shell, 12½"; there is a space of 1⅝" between the shell and stator stampings. Internal diameter of stator, 6", 36 slots, each 7/16" wide × ¾" deep and 3¾" long. I wish to wind this to be a 1 h.p., single-phase, 230 volt, 30 cycle motor, and to have a speed of approximately 1,200 r.p.m.

A.—The motor of which you give dimensions would easily develop 1½ to 2 b.h.p. on a 50 cycle circuit running at 1,400 r.p.m., but if you propose to wind for 30 cycles, the speed and power will be correspondingly less. The speed you name of 1,200 r.p.m. is not possible on 30 cycles, as this corresponds with neither a 2-pole or a 4-pole speed; about 1,700 r.p.m. or 750 r.p.m. are the full load speeds corresponding to this frequency, and if you decide on the latter (which is the easier winding) the power output will be approximately ½ h.p. The following windings will probably give you what you require:—

Rotor. Squirrel-cage type with short-circuited copper bars.

Stator Running Winding. Three main coils per pole group, concentrically arranged, spanning slots 1-9, 2-8 and 3-7 in each quadrant. The three remaining centre slots in each group to be left for the starting coils. Each main coil to contain 50 turns of No. 18 s.w.g. d.c.c. copper with 6 mil. covering.

Stator Starting Winding. Four coils in all, one per pole, spreading right and left from the blank centre slots of the running winding, each coil wound with 100 turns of No. 23 s.w.g. d.c.c. copper.

Starting can be done by an external "Twinob" switch, as described in the handbook, "Electric Motor Management."

Practical Letters

Large-scale Locomotives

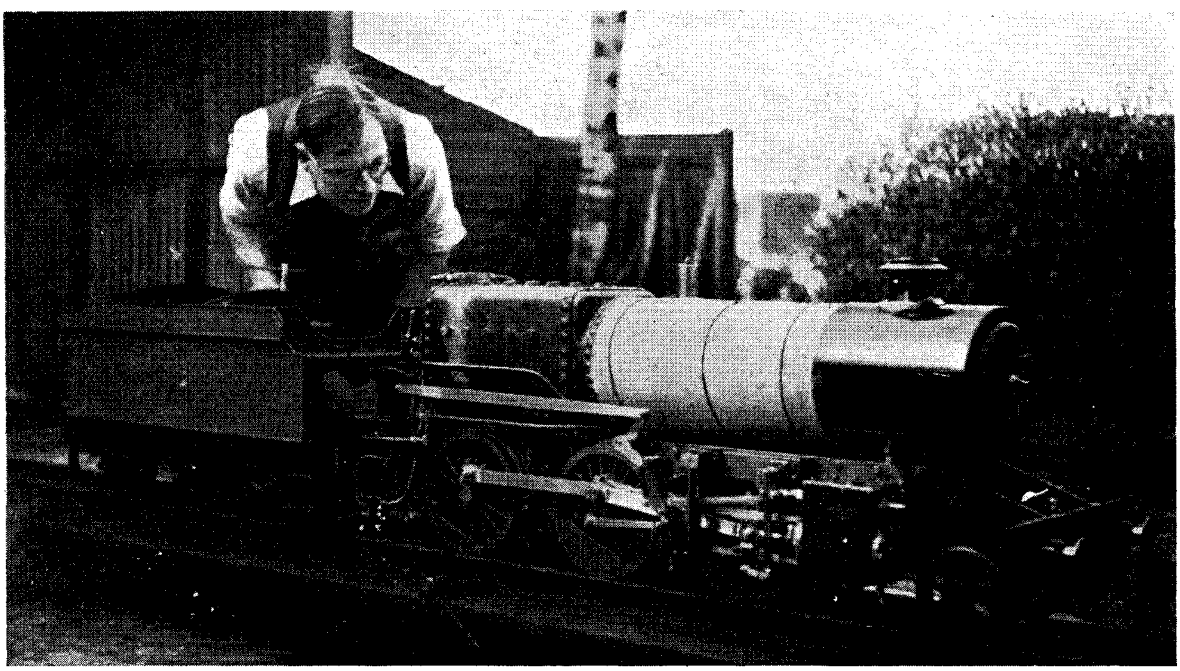
DEAR SIR,—I read Mr. X's letter on the above subject with great interest, and certainly I think his final paragraph regarding the necessity of pleasing the passengers puts the matter in a nutshell. Incidentally, during the five seasons in which I have run the $7\frac{1}{4}''$ gauge "Saltwood Miniature Railway" (open to the public two days a week during the summer months), I have found that it is the trimmings and gadgets such as headlamp, or dummy brake hose, or even the fireman's shovel which seem to delight the public most and excite such appreciative comments as "Oh, look at the tiny shovel" or "the tiny fire" if the firedoor happens to be open, or "Can you light the lamp, Mister?" However, this is by the way; the point I should like to make is that it is possible to retain most of the advantages of somewhat oversize working parts (such as, say, coupling-rods, which are hardly ever strict scale size even in the most swagger "scale model"—working, I mean, not a glass case job) and yet keep a reasonably accurate scale appearance.

Take the case of $7\frac{1}{4}''$ garden railways—although I agree that these are not on the same footing as the big $10\frac{1}{4}''$ and $15''$ gauge lines which are open to the public every day—still, in such a line as the Saltwood Miniature Railway, carrying as it does some 2,500 passengers each season, the question of wear and tear requires careful consideration.

In this connection, it is surprising how much one can "fluff up" the dimensions and still retain a sufficiently "scale" appearance to satisfy the lay, or even the technical eye. This can be done by very careful attention to proportion; for instance, in the new 2-6-0 for the Saltwood line with G.W. exterior (now rapidly approaching completion)—by the way, this engine was referred to in the article on "Choice of a prototype" in THE MODEL ENGINEER a few weeks ago—it was considered advisable to raise the boiler centre line about an inch above the scale height of the corresponding G.W. "Granges"—actually to roughly the same height as the "Kings," but owing to the wider footplating (necessitated by the use of cylinders with slide valves on top and Walschaerts gear—offset outwards as usual) the characteristic squat "tumble-home" (I think that is the correct term) of the G.W. engines in front view has been very faithfully reproduced. If, however, the footplating were scale width the boiler would look too high pitched. This is borne out by a comparison with the existing "Atlantic" (which *is* inside the scale loading gauge) with a high pitched boiler and very short chimney. With the two engines side by side the new 2-6-0 appears to have a smaller overall height from rail level than the "Atlantic," whereas actually it is the other way round, the overall height to top of chimney of the 2-6-0 being $\frac{3}{4}''$ more—incidentally quite a bit outside scale loading gauge, and yet the eye isn't conscious of it at all.

Actually, I imagine that very few, if any, of the so-called scale model engines which do hard work on garden and estate railways, or in public parks, etc., are really to scale in their working parts. An exact scale model would look very "spindly" against such engines.

Also, the oversize Vignoles rails which are usually employed (9 lb. per yard is the smallest commercial size obtainable and "miles" over scale for $1\frac{1}{2}''$ scale!) make it advisable to have wheel tyres, etc., well over scale width. It is surprising, too, how much wear and tear there is even on a well maintained track laid with such stout material.



Mr. Schwab's new 2-6-0 locomotive undergoing a steam test prior to completion.

Now, as regards the discussion of the relative merits of the over scale free-lance engines, usually with big wide firebox boilers, in many cases comparisons have been made between "scale" locomotives with small boilers and excellent valve timing and free-lance engines with oversize boilers, but "not so good" valve events, etc., which has tended to confuse the issue.

A very similar case arose in the classical locomotive exchange between the G.W.R. and L.N.E.R. when the L.N.E. "Pacific" with its outsize in boilers showed up unfavourably against the G.W. "Castle," whereas now that the L.N.E.R. has adopted all Swindon's ideas on valve-setting and maybe "gone one better" in the matter of steam passages, etc., the results shown by published figures of performance of the L.N.E. "Pacifics" can leave little doubt even in the mind of the most ardent G.W. "fan" as to which of the two designs would win in a "flat-out" trial of speed and power.

This last quality is of paramount importance in miniature railway locomotives, as they usually work under heavy load conditions.

Comparative trials between an L.M.S. "Pacific" and a G.W. "King" would be extremely interesting, as the two engines are so much alike, apart from the big wide firebox on the Pacifics. I think there is little doubt that in spite of the similarity of the *nominal* tractive efforts of the two engines, the L.M.S. 4-6-2 would win "hands down" either in a trial of speed and/or loading or on maintenance figures—the wide firebox is probably worked at a much lower rate of combustion—and the same should hold good with miniature locomotives.

Yours faithfully,

Saltwood. A. C. Schwab.

Dear Sir,—I feel I really must write and say that I do not know when, if ever, I have been so interested in a model loco. as the one Mr. Baldwin built for Mr. Maxwell.

I hasten to assure you that had it been a free-lance design my interest would have faded as quickly as it had arisen, if ever it had arisen at all.

The point I would like to make is, that in my opinion the first magnetic attraction to a model, from the point of view of the, shall we say, mass, is its *striking likeness to some real* or tangible thing, and if this thing is known well, then the greater the magnetism.

I am confident no one realises more than I the difficulties experienced by model builders when trying to keep to scale—and often how utterly impossible—if the thing, when finished, has to work for its living.

Of course, the second best attraction is, no doubt, the miniature's ability to work both well and hard, but still I say and believe the nearer to scale *outwardly*, at least, and the more it resembles a known prototype, the greater the value of the finished job, and also the attraction.

I am afraid I am guilty of having to admit that were I in a position of a judge, I should always grant the prize for a good copy in preference to even fine workmanship, quite wrongly, perhaps, but I feel a true copy, when viewed from various angles, seems to live as does the *big sister*. No, free-lance is good practice for engineers, undoubtedly, but give me the one who picks a fine engine and sets to work to copy her, every time. How can an enthusiast compare a model with the real thing if none is available to show it off with. "Cannot be done," say model builders, yet Mr. Baldwin has done it—and it pulls well, I believe.

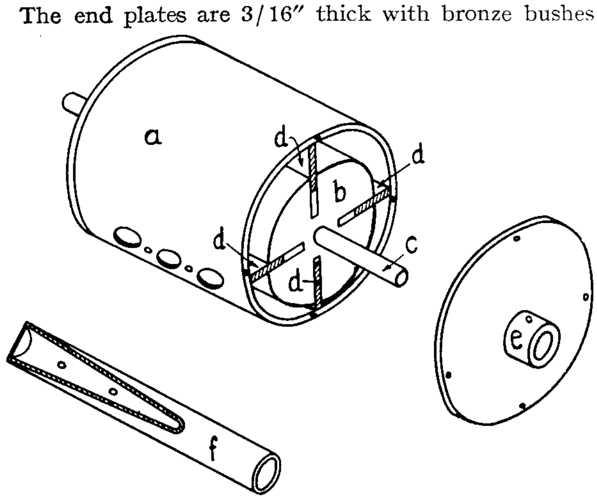
Yours faithfully,

Hitchin. "Bill Massive."

Rotary Blowers

Dear Sir,—In response to the letter of Mr. Arthur Palmer, of Reading, requesting details of the construction of a rotary blower, perhaps the description and sketch of one I made up some time ago may be of interest. It supplied the air for a $\frac{3}{4}''$ gas blowpipe with which I brazed up a $2\frac{1}{2}''$ gauge loco. boiler.

The casing (*a*) was the shell of a starter motor, bought from the local car breaker, this was already machined in the bore to 4″. The rotor (*b*) was cast in aluminium, then drilled to take the $\frac{1}{2}''$ bright steel spindle (*c*), and keyed on. The rotor was turned to $3\frac{1}{2}''$ diameter, and faced on the spindle between centres. I had the four slots milled for me 1″ deep and 3/32″ wide, to suit the fibre vanes (*d*), cut from sheet; thicker vanes would be better, and could be made from a hard wood or other suitable material. The end plates are 3/16″ thick with bronze bushes



Perspective views of parts of a rotary blower.

(*e*), stepped in, the whole being held on with screws and dowel-pins. Three 9/16″ holes were drilled in one side, as shown, just below the half-way line, and a delivery pipe (*f*) was made by cutting a piece of tube at an angle, and blanking the end, the hose being attached to the other end. This was held on by a couple of screws, with a joint between tube and casing. Half-a-dozen holes were drilled in the opposite side of the casing, to allow easy entry of air, and covered with gauze. A pulley, to suit the means of driving, was fitted to the spindle, which is brought through one end. The complete blower was clamped down to the bench by a clip right over the casing and driven from the overhead countershaft. I should think about 1,000 r.p.m. is a suitable speed.

The design and method of building up can be made to suit the materials and equipment available, and will be found quite satisfactory, I think.

Yours faithfully,

Faversham. E. J. Beer.